A SUMMARY OF CURRENT KNOWLEDGE ON THE DISTRIBUTION AND ABUNDANCE OF MOULTING SEADUCKS IN THE COASTAL WATERS OF BRITISH COLUMBIA

Jean-Pierre L. Savard

TECHNICAL REPORT SERIES No. 45
Pacific and Yukon Region 1988
Canadian Wildlife Service

Environment Canada
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Canada

89-00461/

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CANADIAN WILDLIFE SERVICE

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This series may be cited as:

Savard, J.-P.L. 1988. A summary of current knowledge on the distribution and abundance of moulting seaducks in the coastal waters of British Columbia. Technical Report Series No. 45. Canadian Wildlife Service, Pacific and Yukon Region, British Columbia.

Issued under the Authority of the
Minister of Environment
Canadian Wildlife Service

Ministry of Supply and Services Canada 1988
Catalogue No. CW69-5/45E
ISBN 0-662-16450-4
ISSN 0831-6481

Copies may be obtained from:
Canadian Wildlife Service,
Pacific and Yukon Region
P.O. Box 340,
Delta, British Columbia,
Canada V4K 3Y3

ABSTRACT

Little is known about the distribution, density and behaviour of moulting seaducks in the coastal waters of British Columbia. I summarize in this report some of the information available on the distribution of moulting seaducks. Three species of seaducks moult in large numbers in the coastal waters of British Columbia: the Harlequin Duck (Histrionicus histrionicus), the Surf Scoter (Melanitta perspicillata) and the White-winged Scoter (Melanitta fusca). Harlequin Ducks moult in small groups of 20 to 200 birds along rocky shores and are well distributed along the coast. Large numbers of Harlequin Ducks moult in the northwest portion of the Strait of Georgia. Surf Scoters moult in larger groups (100-5,000 birds) in very localized areas. Among the major sites are: Boundary Bay, Hernando Island, Christie Islet in Howe Sound and the islands at the junction of Alice Arm and Hastings Arm in Observatory Inlet. Some of these sites seem to be traditional moulting areas. White-winged Scoters moult also in large groups. Known moulting sites include Comox, Boundary Bay, Bonilla Island and Rose Spit in the Queen Charlotte Islands. Data is lacking however to confirm whether these sites are used every year. Other species found in smaller numbers in the coastal waters in summer, include the Common Loon (Gavia immer), Western Grebe (Aechmophorus occidentalis) and the Greater Scaup (Aythya marila). Threats facing moulting seaducks include oil spills, marine aquaculture, recreational boating, pollution, habitat destruction, and fishery activities. Among some of the research needed are: 1) the location of traditional moulting sites along the coast as only a

small portion of the coast of British Columbia has been surveyed to date; 2) the determination of whether these sites can be used to monitor and/or estimate population sizes; 3) the determination of the moulting chronology and of the composition of major moulting flocks, 4) the characterization of the moulting sites in terms of food, habitat and level of pollution; 5) the determination of relationships between breeding, moulting and wintering areas. Results of this research will benefit the many agencies involved in coastal development, impact assessment and policy development and will allow wildlife agencies to better monitor the health of seaduck populations and to adequately manage them.

RESUME

Il y a peu d'information sur la distribution, l'abondance et le comportement des canards de mer qui muent dans les eaux cotières de la Colombie Britanique. Je regroupe dans ce rapport une partie de l'information qui existe sur la distribution des canards de mer durand la période de la mue. Trois espèces de canards muent en grand nombre dans les eaux cotières de la Colombie Britanique. Ce sont le Canard Harlequin (Histrionicus histrionicus), la Macreuse a Front Blanc (Melanitta perspicillata) et la Macreuse a Ailes Blanches (Melanitta fusca). Le Canard Harlequin mue en petit groupes comprenant entre 20 et 200 individus le long de rivages rocheux et se retrouve tout le long de la côte. Ils sont particulièrement abondants dans la section Nord-ouest du détroit de Georgia. La Macreuse a Front Blanc mue

en gros groupes (100-5,000 oiseaux) a des endroits très localises. Parmi les sites les plus importants on retrouve: la baie Boundary, l'Île Hernando, l'îlot Christie dans le détroit de Howe et les îles a la jonction des bras Alice et Hastings dans le passage Observatory. Certains de ces sites semblent être des endroits traditionels de mue. La Macreuse a Ailes Blanches, mue aussi en gros groupes. Les sites importants incluent Comox, la baie Boundary, l'Île Bonilla et extrémité nord-est de l'Île Graham dans les Îles de la Reine Charlotte. La stabilité de ces concentrations n'a pas été établie cependant. Parmi les autres espèces qui fréquentent les eaux cotières en été, on retrouve le Huart a Collier (Gavia immer), le Grèbe de l'ouest (Aechmophorus occidentalis) et le Grand Morillon (Aythya marila). Plusieurs menaces pèsent sur les canards de mer en mue: les déversements pétroliers, l'industrie d'aquaculture marine, les bateaux de plaisance, la pollution, la destruction de l'habitat, les activités de pêche. Les besoins en recherche incluent: 1) la localisation des sites de mue traditionels; jusqu'à présent une petite partie seulement des eaux cotières de la Colombie Britanique a été inventoriée; 2) déterminer si les sites de mue peuvent être utilisés pour suivre et/ou estimer les effectifs de canards de mer d'une année a l'autre; 3) déterminer la chronologie et la composition des principaux groupes en mue; 4) caractériser les sites de mue en terme de disponibilité de nourriture, d'habitat, et de degré de pollution; 5) déterminer les relations entre les sites de nidification, de mue, et d'hivernage. Les résultats de ces recherches seront utiles aux

divers organismes impliqués dans les dévelopements cotiers, dans les études d'impacts et dans le dévelopment de politiques. Ils devraient aussi permettre aux organismes fauniques d'effectuer un meilleur suivi de la santé des populations de canards de mer et de les aménager de facon adéquate.

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ACKNOWLEDGEMENTS

I thank G.W. Kaiser, K. Vermeer, R. Butler, S. Wetmore, and N. Dawe for their comments on various drafts of this manuscript. Thanks also to P.M. Whitehead and L. Willis for their assistance in drafting the figures, and to S. Garnham for typing the manuscript. I am also grateful to G.W. Kaiser, S. Boyd and R. McKelvey for their field assistance, and to W.C. Campbell for providing access to the British Columbia Wildlife Record Scheme. This work was funded and supported by the Canadian Wildlife Service.

There are indications that large numbers of ducks moult in the coastal waters of British Columbia (Patch 1922, Guiguet 1953, Hay 1976, Vermeer and Levings 1977, Hatler et al. 1978, Martin 1978). However, the limited number of surveys during the July-August moulting season hinders our ability to assess the distribution, abundance and behaviour of these birds. In addition, our knowledge of seaduck moulting ecology is limited and also impairs our ability to successfully manage these species.

Seaducks are vulnerable to industrial activities during the moult. They are flightless, they concentrate, and they may have relatively high energy demands at this time (Weller 1957, Young 1977). In view of the increased maritime traffic along the west coast and of the probable renewal of offshore petroleum exploration it is urgent to document the abundance, distribution, and habitat requirements of moulting seaducks so that a baseline exists from which to define sensitive areas and assess potential impacts. This information will also help direct the development of the rapidly expanding aquaculture industry and minimize its impact on seaduck populations.

My objective in this report is to bring together the existing information on moulting seaducks in the coastal waters of British Columbia. This report includes information contained in an unpublished CWS Regional Report entitled "Moulting ducks in the coastal waters of British Columbia" (Savard 1981) as well as the results of new surveys conducted since its completion. It also summarizes the Royal British Columbia Museum Wildlife Records Scheme (BCWRS) for the months of July and August for Harlequin Ducks (Histrionicus histrionicus), Surf Scoters

(Melanitta perspicillata) and White-winged Scoters (M. deglandi) which moult in great numbers in B.C. coastal waters. The report identifies major threats to moulting ducks and areas for future research.

METHODS

1. Historical records

The major sources of historical records were the sight records from the British Columbia Wildlife Record Scheme (BCWRS) and published literature. The sight cards report casual sightings by observers. Therefore the absence of sightings for an area may reflect more the absence of observers than the absence of birds. In spite of limitations, these data are useful in suggesting potential moulting sites. In some cases repeated sightings for an area may indicate traditional moulting areas. I have summarized only sightings during July and August because this is the period when seaducks are most likely to moult. I mapped the sightings of the three major species of seaducks moulting along the coast of British Columbia: Harlequin Duck, White-winged Scoter and Surf Scoter. For each site where these species had been sighted I classified the foreshore as either cliffs, rocks, sandy and muddy based on nautical charts. For each species, I then totalled the number of birds seen along each type of foreshore.

2. Surveys

In the last decade, several surveys were done to locate concentrations of moulting seaducks:

1) In 1980, aerial surveys were carried out from a Beaver aircraft at a speed of 190 km/h and an altitude of 60 m. Observations were recorded on cassette tapes and transcribed at the end of each survey. The emphasis of the survey was on the location of moulting concentrations of ducks, although all birds seen were recorded. Aerial surveys were flown between July 28 and 31 in Chatham Sound (54°N 130°W), Hecate Strait (53°N 131°W) and Dixon Entrance (54°N 132°W); and on August 7 in Boundary Bay (49°N 123°W) near Vancouver. Several ground surveys were conducted in Boundary Bay throughout the summer and one in the Queen Charlotte Islands on July 31. Also, a detailed behavioural study of moulting Harlequin Ducks was done in 1984 near White Rock British Columbia.

2) On August 14, 1985, an aerial survey was flown over Boundary Bay, Indian Arm and Howe Sound using a Cessna 185 on floats at an altitude of 70 m. Only moulting concentrations were recorded during this survey.

3) On August 7, 8 and 25 1986, surveys were flown in Portland Inlet, Skidegate Inlet, Douglas Channel and over Hecate Strait from a Cessna 337. Again only concentrations of seaducks were recorded during the survey.

RESULTS

1. Harlequin Duck

A) Data from the literature and the British Columbia Wildlife Record Scheme

Reports of Harlequin Ducks moulting in coastal waters of British Columbia are numerous (Guiguet 1953, Campbell 1964,

Campbell and Kennedy 1966, Kennedy and Foottit 1967, Foottit 1968, Foottit and Butler 1970, Hatler et al. 1978 and Martin 1978). Their moulting habits are similar to those of other populations of Harlequin Duck in Alaska and Iceland which also moult at sea (Gabrielson and Lincoln 1959, Bengston 1966).

The BCWRS indicate that moulting Harlequin Ducks are widely distributed along the B.C. coast including the Queen Charlotte Islands. Moulting flocks were reported from 84 locations along the coast during July and August (Appendix 1). At 61 (73%) of these locations, flocks contained less than 50 birds; only 12 (14%) sites had flocks of over 100 birds. No flocks over 500 birds have been reported. Sites with over 100 moulting birds included the Chain Islets off Victoria, Helliwell Park on Hornby Island, Cape Lazo near Comox, Mitlenatch Island, Oyster and Shelter Bays south of Campbell River. The site with the largest concentration of Harlequin Ducks was Mitlenatch Island with several records of over 300 birds (Appendix 1). Based on these records, the northwest section of Georgia Strait is an important moulting area for this species. More Harlequin Ducks were sighted along rocky shores (73%) than along sandy shores (28%) (Table 1). Harlequin Duck sightings were more restricted to rocky type shores (cliff and rocks) than those of Surf and White-winged scoters.

B) Data from surveys

Few Harlequin Ducks were seen during aerial surveys (Appendices 4,5,6). This probably reflects more, deficiencies in survey techniques than absence of Harlequins.

Table 1. Distribution of moulting seaducks according to foreshore type[1] as determined from nautical chart.

Area / Species	Foreshore Type						
	Cliff		Rock		Sand		n
		%		%		%	
Queen Charlotte Islands							
Harlequin Duck	540[2]	(50)	308	(29)	223	(21)	1071
Surf Scoter	1588	(53)	190	(6)	1218	(41)	2996
White-winged Scoter	744	(25)	60	(2)	2189	(73)	2993
North end Vancouver Island							
Harlequin Duck	141	(20)	395	(56)	167	(24)	703
Surf Scoter	2856	(38)	490	(7)	4135	(55)	7481
White-winged Scoter	169	(4)	51	(1)	4513	(95)	4733
South end Vancouver Island							
Harlequin Duck	1173	(56)	253	(12)	686	(32)	2112
Surf Scoter	3044	(60)	500	(10)	1546	(30)	5090
White-winged Scoter	4233	(51)	1500	(18)	2618	(31)	8351
Total area							
Harlequin Duck	1854	(48)	956	(25)	1076	(28)	3886
Surf Scoter	7488	(48)	1180	(8)	6899	(44)	15567
White-winged Scoter	5146	(32)	1611	(10)	9320	(58)	16077

1 - No birds of any of the three species were sighted over muddy type foreshores.

2 - Total number of individuals reported along a given type of foreshore.

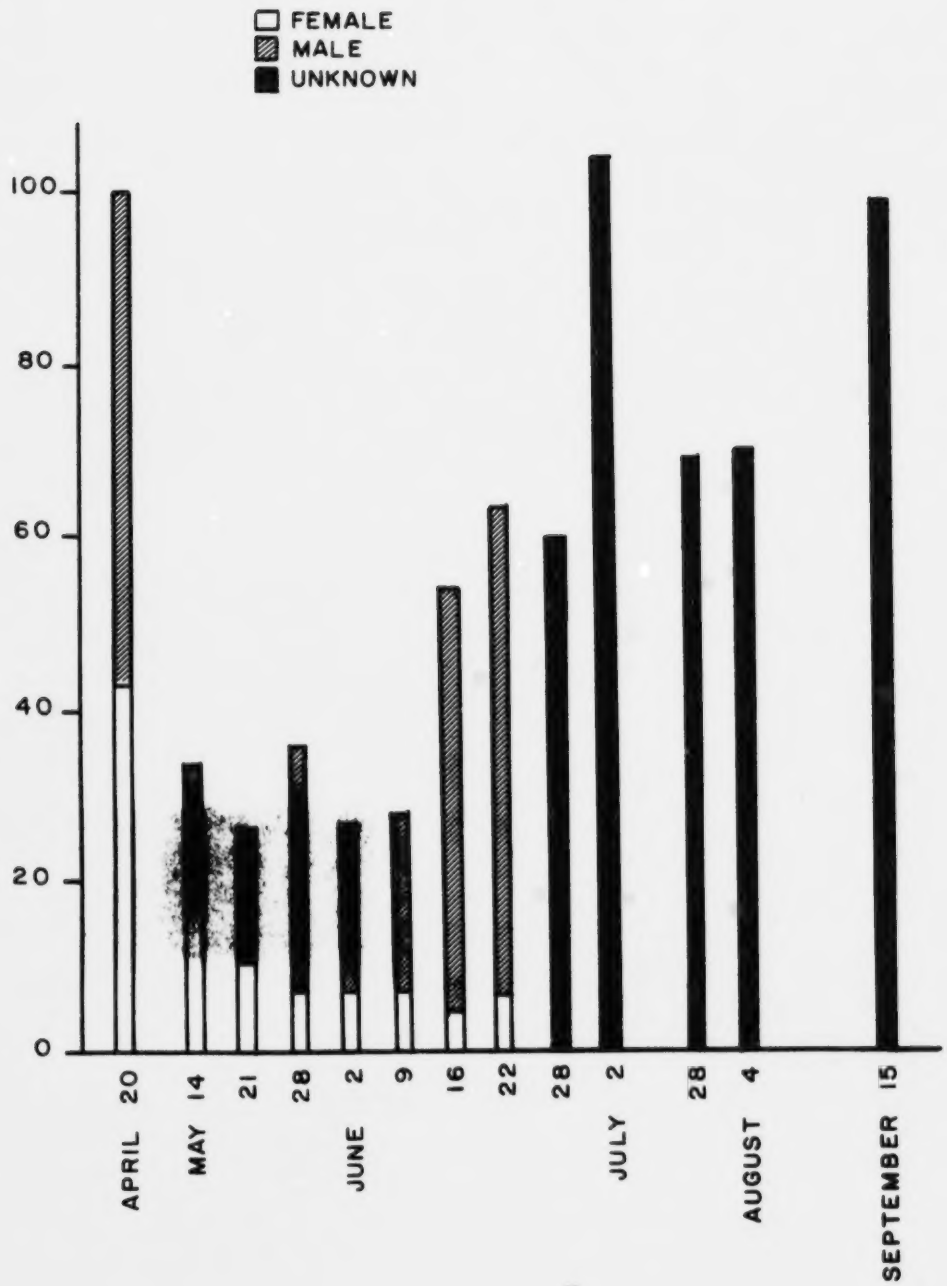
The habit of Harlequin Ducks of resting among rocks close to shore impairs their detection from the air. This is compounded by their cryptic eclipse plumage which blends with adjacent rocks and floating kelp. During an aerial survey of Harlequin Ducks in Boundary Bay, only half of the 70 birds present were detected from the air.

During aerial surveys, especially those of 1980 we attempted to survey several species concurrently and concentrated on large flocks so that inconspicuous species such as Harlequin Ducks had less chance of being observed. Multiple species counts are less accurate than single species counts (Watson et al. 1969; Savard 1982). This was further compounded by the location of our flight lines 100 m from the tide line which impaired the detection of Harlequin Ducks from the air. Aerial surveys, limited to Harlequin Ducks and conducted at low altitudes along the tide line, might prove more effective in detecting that species.

C) Population study

A small population of Harlequin Duck was monitored from April to September 1980 near White Rock, B.C. Numbers fluctuated between 25 and 100 individuals (Fig. 1). The birds observed from May 14 to June 9 were probably non-breeders. The increase in numbers of Harlequin Duck drakes observed on June 16 probably represents the return of males from the breeding ground because the number of females did not change. Palmer (1976) and Bengston (1966) mentioned that males spend approximately four weeks on the breeding grounds before returning to sea. Counts indicate that the migration to breeding grounds took place between April 21 and

FIG. 1 NUMBER OF HARLEQUIN DUCKS OBSERVED ALONG 4 KM OF SHORELINE NORTH OF WHITE ROCK B.C.



May 14. More frequent counts would be required to pinpoint the event.

By June 28, 25% of the males had begun their postnuptial moult and were acquiring their eclipse plumage. On July 28, all males were in eclipse plumage and flightless. By mid-September the males were moulting to their nuptial plumage and were capable of flight.

Moulting Harlequin Ducks were relatively tame. They reacted to hikers moving along the shore by going into the water but returned to shore as soon as the disturbance passed. On one occasion the birds moved on shore when a seal approached them from the water. Moulting Harlequin Ducks reacted to boats by going into the water and swimming in a long line close to shore in very shallow water. Reaction to low flying aircraft was observed only once. Most birds resting on rocks went into the water, although a few remained on shore.

During all counts from April 20 to mid-September Harlequin Ducks remained within 50 m of shore. During their flightless period they spent most of their time resting on exposed rocks. This is reflected in the activity pattern recorded on July 28 from 0600 to 1400 hours (Figs. 2 and 3). All birds fed simultaneously in the early morning but after 0900 hours only small numbers of birds fed at any one time. Harlequin Ducks spent most of the daylight hours resting and preening on the shore (Fig. 3).

FIG 2 PERCENTAGE OF HARLEQUIN DUCKS FEEDING THROUGHOUT THE DAY (July 28)
(NUMBER OF BIRDS OBSERVED RANGED FROM 30-80)

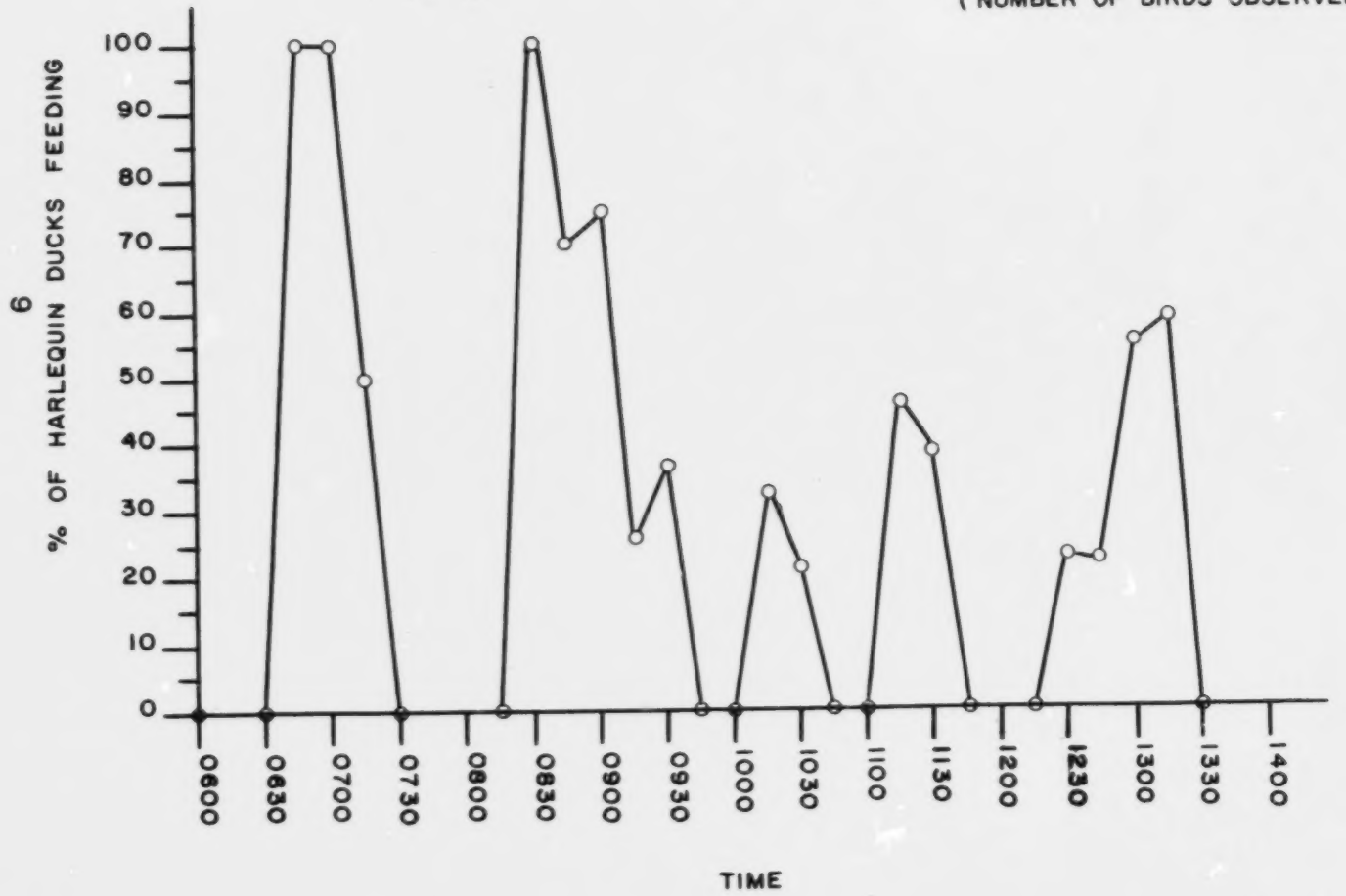
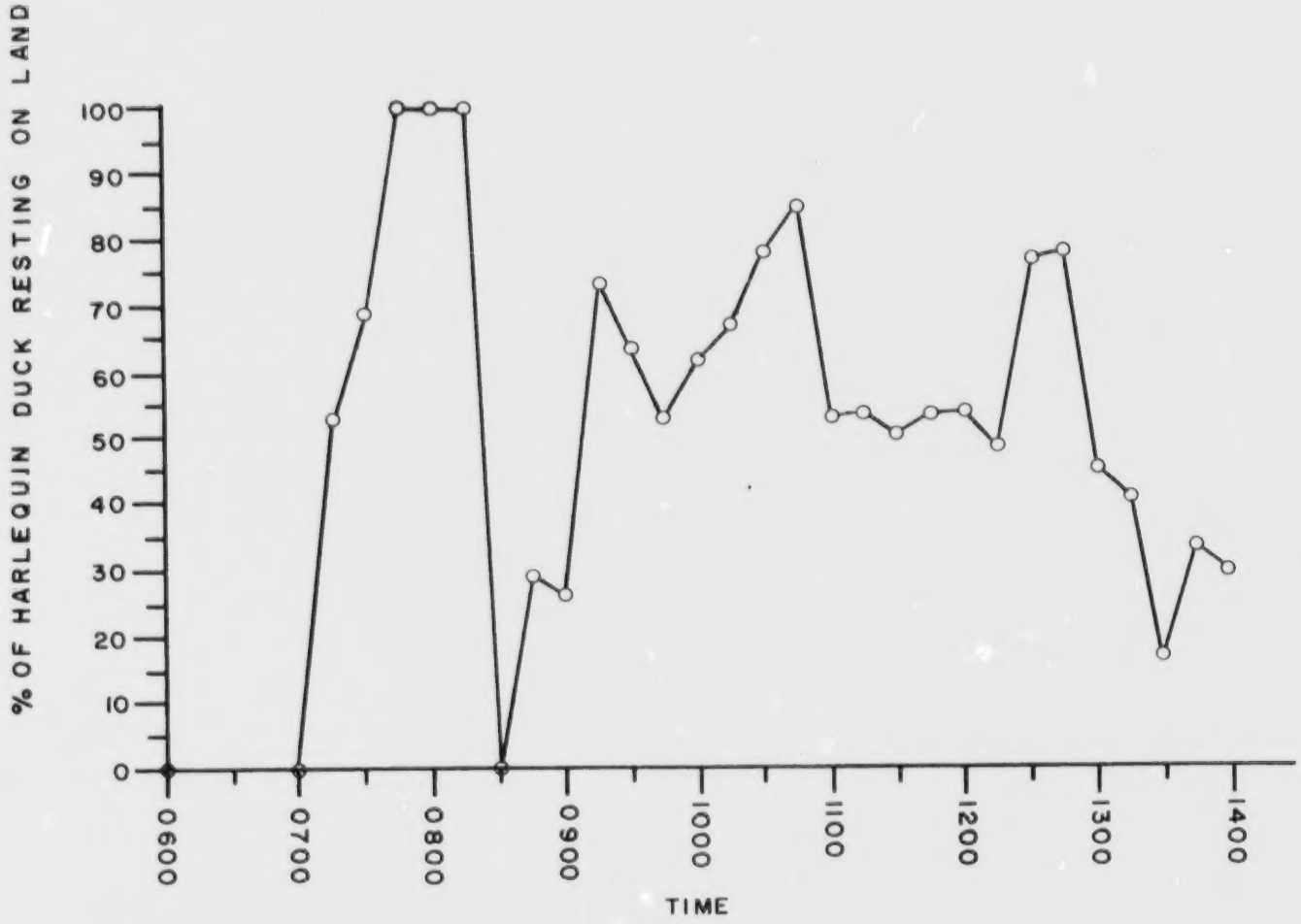


FIG 3 PERCENTAGE OF HARLEQUIN DUCKS RESTING ON LAND THROUGHOUT THE DAY (THE NUMBER OF BIRDS UNDER OBSERVATION RANGED FROM 30-80) (July 28)



2. Surf Scoter

A) Data from the literature and the British Columbia Wildlife Record Scheme

Flocks of scoters were reported at 94 locations along the coast during July and August (Appendix 2). At 68 (72%) of these locations, flocks contained less than 100 individuals. Flocks of 100 to 500 individuals were reported at 20 sites (21%) and there were only 8 sites with flocks of over 500 birds: Hernando Reef, Tsawwassen, Christie Islet in Howe Sound, Douglas Channel, Grenville Channel, Rose Spit and Vargas Island.

More Surf Scoters were seen along rocky shores (56%) than along sandy shores (44%), and none were seen over muddy shores (Table 1).

B) Data from Surveys

Moulting flocks of Surf Scoters were very localized. The largest concentration was located around a group of islands at the junction of Alice Arm and Hastings Arm in Observatory Inlet. In 1986, I estimated 5,000 Surf Scoters in the sector (Appendix 6). In 1980, when only a small section of this sector was surveyed, 800 Surf Scoters were counted (Appendix 4). In 1976, at the same location, 3,000 Surf Scoters were counted by Chris Easthope (CWS Unpublished data). These observations show that some moulting sites are used for several years and may be traditional. This concentration is highlighted by the absence of Surf Scoters elsewhere in Observatory Inlet.

Another large moulting flock of Surfs Scoters occured in Boundary Bay near Vancouver where 2,000 to 4,000 scoters were counted in August 1980 (Appendix 4) and again 3,000 to 4,000 in

August 1985 (Appendix 5). Vermeer and Levings (1977) also reported large numbers of moulting Surf Scoters in Boundary Bay. In 1986 Surf Scoters were scattered in flocks of 50 to 300 individuals in the Bay with 2 major concentrations: one on the west side of the Bay and one on the east side (Appendix 5, Fig. 5.1).

A flock of 300 to 800 moulting Surf Scoters is located near Christie Islet in Howe Sound. It was first reported in 1977 (Appendix 2), and was seen again during the aerial survey of 1985 (Appendix 5). A concentration of moulting Surf Scoters was observed in Skidegate Inlet in 1980 (Appendix 4) and again in 1986 (Appendix 6). Another important concentration of Surf Scoter was located in 1986 in Douglas Channel near the northern tip of Hawkesbury Island (Appendix 6). Like previous ones, this appears to be a stable moulting location. Chris Easthope (CWS unpublished data) reported 2,000 birds there in 1976 and Hay (1976) also reported moulting flocks there.

These observations strongly suggest that some moulting sites are well defined areas that are used each year, thus the importance of identifying these areas and determining what attracts birds. Traditional use of these sites raises the possibility of using them to monitor population changes in the species.

Males tended to predominate summer concentrations of Surf Scoters, but the exact composition of moulting flocks has not been established yet. The sex ratio of a small group of Surf Scoters in Boundary Bay during the months of July and August averaged

Table 2. Sex ratio of Surf Scoters observed along a 4km long shoreline in Boundary Bay during the summer of 1981.

Date		Number of males	Number of females	Males/ female
July	2	77	32	2.41
	7	154	122	1.26
	9	180	76	2.37
	10	298	103	2.89
	13	281	65	4.32
	17	220	36	6.11
	21	387	88	4.40
	23	524	75	6.99
	29	276	45	6.13
August	4	238	118	2.02
	17	148	117	1.26
	21	201	89	2.26
Total		2,984	966	3.09

3.54±0.58 males per female and ranged between 1.26 and 6.99 (Table 2). Winter sex ratios for the same area averaged 1.84±0.29 males per female (n=6 counts). Palmer (1976) suggests that both pre-breeding and post-breeding birds are involved and Anweiler (1974) reports an influx of males in July and August. Along the Beaufort Sea coast of the Yukon Territory only post-breeding males have been reported (Gollop et al. 1974, Vermeer and Anweiler 1975, Johnson et al. 1975).

3. White-winged Scoter

A) Data from the literature and the British Columbia Wildlife Record Scheme

Several authors (Patch 1922, Palmer 1976, Hay 1976, Vermeer and Levings 1977, Hatler et al. 1978) have reported White-winged Scoters moulting in British Columbia coastal waters. Palmer (1976) indicates that the centre of abundance of summering pre-breeders is in waters of southeastern Alaska.

Flocks of White-winged Scoters were reported at 84 locations along the coast during July and August (Appendix 3). Flocks of less than 100 individuals were reported at 63 (75%) of these sites, of 100 to 500 birds at 15 sites (18%) and over 500 birds at 6 sites (7%). Sites with more than 500 birds were: Royston near Courtenay, Comox, the west side of Vargas Island; Barkley Sound; Cape Beal near Barkley Sound; and McIntyre Bay in the Queen Charlotte Islands. White-winged Scoters were sighted more often along sandy foreshores (58%), than along rocky shorelines (42%) and none were observed over muddy shores (Table 1).

B) Data from surveys

White-winged Scoters were the most abundant duck observed in aerial surveys conducted in the Queen Charlotte Islands in 1980 (Appendix 4). They were widely distributed throughout the censused area and a large concentration was located on July 29 near Bonilla Island. The birds were assembled in compact flocks of a few hundred, totalling at least 1,500 individuals. Similar concentrations have also been observed near Bonilla Island in fall and winter, indicating the importance of the area for White-winged Scoter (Savard 1979). In 1986, however, we could not locate this moulting concentration (Appendix 6). Whether birds had changed moulting site or whether we missed the flock, cannot be ascertained as we could not cover the whole area thoroughly. Further surveys are needed to establish the status of this moulting site.

No other large moulting concentrations of White-winged Scoters were located during the 1980 and 1986 aerial surveys (Appendices 4-6). Although high densities of White-winged Scoters were recorded in McIntyre Bay in 1980, the birds were scattered and did not form compact flocks like those near Bonilla Island. Patch (1922) mentions that the beach of McIntyre Bay was frequently "littered with feathers" of moulting scoters. In 1986 no large flocks were located in McIntyre Bay but again our coverage of the area was minimal.

Sex ratios taken during a ground survey along 10 km of shoreline near Sandspit in the Queen Charlotte Islands on July 31 yielded 368 males, 11 females and 21 unclassified individuals (Appendix 4). Most males were in nuptial plumage and probably had

not yet initiated their moult. The predominance of males in the counts indicates that they might be breeding birds that had returned from the nesting areas.

Aerial surveys may have missed some concentrations of White-winged Scoters. Shallow waters near Skedans Island, Bonilla Island and Rose Spit should be surveyed more intensively to monitor the build-up to the large numbers that winter there (Savard 1979).

4. Other species

Regular surveys along a 4km length of shoreline near White Rock, British Columbia indicate that several species of aquatic birds spend the summer in coastal waters (Table 3). The three seaduck species discussed earlier were the most abundant summer residents, but other species were also seen in small numbers: Black Scoters (Melanitta nigra), Oldsquaws (Clangula hiemalis) and Scaups (Aythya sp.; probably marila).

A) Black Scoter

No mention of moulting Black Scoter was found in the literature for the coast of British Columbia. Palmer (1976) indicates only that the species moults in the Bering Sea, and Ross (1983) estimated that over 80,000 moulted in James Bay. A total of 26 Black Scoters, 17 males and 9 females, were observed in the Queen Charlotte Islands during July 1980 surveys (Appendix 4). Also, a few Black Scoters were seen in Boundary Bay during summer surveys (Table 2). This indicates that at least some Black Scoters moult in the coastal waters of British Columbia.

Table 3. Seasonal fluctuation in the number of aquatic birds along a rocky-sandy shoreline near White Rock, British Columbia.

	1980			1981								
	Nov	Dec	Dec	Jan	Feb	May						
	26	9	18	12	5	6	8	11	20	22	26	28
Common Loon	9	13	14	3	6	8	11	13	17	12	10	45
Arctic Loon				9	10	1	24		12	1	2	
Red-necked Grebe	26	15	4	2	4	16	20	20	26	32	38	11
Horned Grebe	95	97	75	38	35	53	103	15	1			
Western Grebe	10	13	1			126	557	138	10	38	15	112
Double-crested Cormorant					3	1	2	1	4	7	2	1
Pelagic Cormorant	22	29	13	15	7	54	96	73	100	99	43	80
Scaup	3646	3159	2245	824	289	107	76	97	11	12	38	127
Common Goldeneye	84	109	77	49	58							
Barrow's Goldeneye	6	4	1	12	2	2	3	1	1	2		2
Bufflehead	49	50	37	36	40	9	10	7				
Oldsquaw	23	24	21	7	10	44	25	9	16	6	3	2
Harlequin Duck	70	60	74	71	68	36	63	45	61	51	50	44
White-winged Scoter	160	98	79	77	82	34	84	72	60	44	33	63
Surf Scoter	704	464	367	168	422	129	140	117	300	80	85	132
Black Scoter	310	380	300	222	206	17	29	50	5	58	29	5
Common Merganser												
Red-breasted Merganser	68	100	63	28	24	13	14	19	12	3	1	
Ruddy Duck	1069	648	1164	1694	907			1				
Common Murre						1			1		2	5
Pigeon Guillemot						2	16	4	16	5	23	14
Marbled Murrelet	4	4		2								

Continued

Table 3. Seasonal fluctuation in the number of aquatic birds along a rocky-sandy shoreline near White Rock, British Columbia.

	1981																
	June				July										August		
	2	4	9	19	2	7	9	10	13	17	21	23	28	29	4	17	21
Common Loon	24	54	22	17	3	18	15	18	10	10	12	13	6	12	34	32	59
Arctic Loon	1	175		5											1		
Red-necked Grebe	10	11	9									1			3	6	14
Horned Grebe																	4
Western Grebe	70	103	72	14	320	41	74	29	56	67	143	284	127	19	60	7	115
Double-crested Cormorant	8	7	3	3													
Pelagic Cormorant	128	185	141	79	40	8	1		21	16	22	6	4	4	4	4	2
Scaup	5		10			185	45								1		
Common Goldeneye																	
Barrow's Goldeneye																	
Bufflehead																	
Oldsquaw	4		8	5	6	25	17	13	15	31	17	15	30	15	11	24	29
Harlequin Duck	21	24	35	46	57	57	69	90	56	61	68	68	73	74	73	93	90
White-winged Scoter	60	193	237	258	44	234	300	399	174	123	311	311	303	323	160	180	302
Surf Scoter	202	106	108	55	109	276	256	401	348	256	475	599	856	321	356	265	290
Black Scoter	11	11	35		1	1			9	30		6					24
Common Merganser																	
Red-breasted Merganser																	
Ruddy Duck																	
Common Murre		5		1		1											
Pigeon Guillemot	9	4	7	10	1					4	2	1	1	2	2	3	
Marbled Murrelet	23	120	8	15	15				2		3	9			5		1

B) Oldsquaw

Only one Oldsquaw was observed in the aerial surveys of 1980, although Vermeer and Levings (1977) reported several hundred Oldsquaws summering in Boundary Bay. The absence of this species from our surveys may have been due to the location of our survey lines only a few hundred meters from shore, because Oldsquaws often frequent deeper waters than scoters (Vermeer and Levings 1977, Savard 1985). Summer surveys in Boundary Bay suggest that some birds spend the summer in the coastal waters of British Columbia (Table 2). Small numbers have been reported off Mitlenatch Island through July and August (R. Butler pers. comm.).

C) Greater Scaup

Scaups have been reported moulting in the coastal waters of British Columbia (Hay, 1976, Vermeer and Levings 1977). Palmer (1976) mentioned that most Greater Scaups moult on inland lakes but that a few moult at sea. Only a few flocks of scaups were recorded during the 1980 aerial surveys in the Queen Charlotte Islands (Appendix 4).

Some Common Loons (Gavia immera) and Western Grebes (Aechmophorus occidentalis) also spend the summer in B.C. coastal waters. Those are probably subadults who did not or do not migrate to their breeding area. Concentrations of post-breeding Red-necked Grebes (Podiceps nigricollis) have been reported in Boundary Bay in mid-August. Grebes and loons are thought to moult their wing feathers in the fall or winter (Palmer 1962),

but the exact chronology of the moult has not yet been documented for most species. Similarly, Ruddy Ducks are one of the rare waterfowl to moult their primaries twice a year, once in late summer on the breeding areas, and once during winter (Palmer 1976). Several hundred Ruddy Ducks winter in Boundary Bay near White Rock, B.C. (Savard 1985) but nothing is known of their ecology and moult chronology there.

5. Threats to moulting seaducks

A) Oil Spills

Seaducks are extremely vulnerable when moulting because they become flightless and often form large and compact flocks. Scoters are especially vulnerable to oil spills (Clapp et al. 1982) and oil related deaths have often been documented (Aldrich 1938, Smail et al 1972, Vermeer and Vermeer 1974, Joensen and Hansen 1977, Vauk 1980, Clapp et al. 1982; Hooper et al. 1987).

B) Marine aquaculture

The development of the aquaculture industry along the coast could potentially threaten some moulting sites by either changing the habitat or by excluding birds from their traditional sites. Moulting seaducks in turn can create problems for some types of aquacultures, i.e. shellfish, by exploiting this new and accessible source of food.

C) Recreational boating

Boating is a potential threat but may not be permanent. Birds, unless continuously harassed, can usually adapt to some disturbance. However, any habitat change (i.e. construction of

marinas) or permanent disturbance could have a significant impact on moulting birds.

D) Pollution

Toxic pollution could affect the health of moulting seaducks. The largest concentration of moulting Surf Scoters found along the coast occurs at the mouth of Alice Arm, a polluted area. Similarly, moulting scoters in Howe Sound could be subjected to high levels of pollution. Toxic pollution can affect the birds either directly or by affecting the abundance and quality of food in the moulting areas. It may also affect the reproductive success of these birds (Hoffman and Albers 1984, Ohlendorf et al. 1986).

E) Habitat destruction

In view of the growing population and increasing natural resource needs, habitat destruction is a continuous threat. Industrial expansion, growth of the aquaculture industry, and growth of the recreation industry brings the need for more marinas and wharves, and logging, all of which could potentially destroy moulting sites directly or indirectly.

F) Fisheries

Drowning of wintering waterfowl in fishing nets can often be important in areas of high fishing intensity (Kirchhof 1982). Net fishing activities near important moulting sites could potentially cause high mortality.

6. Research Needs

Our level of knowledge on the distribution and ecology of moulting seaducks in the coastal waters in British Columbia is limited. Only a small fraction of the coast has been inventoried and little is known of the behaviour and ecology of moulting seaducks in British Columbia or in the world (Joensen 1973, Gollop et al. 1974). Considering the potential threats to these birds, some of the knowledge gaps should be filled. Presently, we do not have the information necessary to adequately manage these birds. Current impact assessments of coastal development (industrial, aquaculture) are impaired by this lack of information.

I list below a general list of research needs concerning moulting seaducks. The results of this research will benefit many agencies involved in coastal development, impact assessment and policy development. It will also allow wildlife agencies to better monitor the health of seaduck populations and to adequately manage them.

A) Locate important moulting sites

Only a small portion of the coast has been surveyed to locate moulting concentrations of seaducks. Other areas that were surveyed once require more intensive surveys: Bonilla Island, Rose Spit and McIntyre Bay in the Queen Charlotte Islands.

B) Determine the stability of moulting sites.

There is some indication that major moulting sites of Surf Scoters and Harlequin Ducks are used consistently from year to

year. However we have little data indicating whether the numbers of birds using these sites remain constant from year to year. Also, we do not know whether moulting sites of White-winged Scoters are used as consistently as those of Surf Scoters. Once the dynamic of moulting flocks is known it may be possible to monitor and even estimate size of populations by surveying important moulting areas.

C) Determine moulting chronology and the composition of moulting flocks

We have little data on moulting chronology and whether moulting sites are used at other times of the year. For example, do Surf Scoters have similar moult chronology in Boundary Bay and in Alice Arm? It is important to determine when birds become flightless and for how long, and whether all age and sex groups moult simultaneously. If not, then an oil spill could affect different portions of the populations depending on when it occurred.

Also, nothing is known of the relationships between moulting sites, breeding areas and wintering areas: Do birds of the same moulting flock originate from the same breeding area? Do they use the same wintering areas? What is the level of exchange between moulting sites? Those are not easy questions to answer, but are important because the impact of an oil spill or the destruction of a moulting site will have different implications depending on the answers.

D) Characterize moulting sites.

It is important to quantify the features of good moulting sites so that we can determine what attracts birds, what determines their numbers and to assess whether the sites are limiting along the coast. Such data would allow us to identify potential moulting areas and to rehabilitate disturbed habitats.

E) Determine pollution levels at major moulting sites.

What is the level of contamination, if any, of the food at various moulting sites along the coast? What is the level of contamination in scoters at these moulting sites? Growing primary feathers are known to concentrate heavy metals, thus may provide estimates of the level of toxics in a given area. Are scoters affected by pollution levels? Some toxic contamination affects reproductive output and could lead to population decline without any obvious dying off of birds (Hoffman and Albers 1984, Ohlendorf et al. 1986).

CONCLUSION

A few studies have been done to describe the dynamics of moult in various species. These studies have documented a decrease in breast muscle during the moult paralleled with an increase in leg muscle (Hanson 1962, Ankney 1979, Young and Boag 1982). Originally this metabolising of muscle protein was taken as an indication of nutritional stress during the moult (Hanson 1962). However, recent studies suggest that this may not be so and that the fact of not using the breast muscle causes their atrophy (Aukney 1979, Young and Boag 1982). Also, some authors

explain the low body mass of ducks during wing moult as an adaptation to resume flight as early as possible (Douthwaite 1976, Pehrsson 1987). Recently Piersma (1988a,b) showed that moulting Great Crested Grebes (Podiceps cristatus) spent less time feeding and dived less often, and suggested that grebes are trying to minimize the risk of breaking the exposed and fragile flight feathers under water.

These studies indicate that more research is needed to fully understand the requirements of moulting birds and the stress associated with moult. Although some birds may not feed extensively during the moult, they may do so prior to or after, or may require specific feeding conditions during that time. Also, requirements may vary among species. It is therefore important to identify the needs of moulting birds to fully assess the importance and uniqueness of moulting sites.

At least six species of ducks moult in the coastal waters of British Columbia: White-winged Scoter, Surf Scoter, Black Scoter, Harlequin Duck, Oldsquaw and Greater Scaup. Among those species, the White-winged Scoter, Surf Scoter and Harlequin Duck are widely distributed and occasionally form large conspicuous, and apparently stable concentrations.

Moulting Harlequin Ducks are found mainly along rocky shores, whereas moulting Surf and White-winged scoters are found along both rocky and sandy foreshores, but with possibily Surf Scoters preferring rocky shores, and White-winged Scoters sandy shores.

Several important moulting sites have already been identified along the coast of British Columbia. Boundary Bay is important

for almost all species of seaducks during the moult. The junction of Hasting Arm and Alice Arm in Observatory Inlet is a very important site for Surf Scoters as more than 5,000 birds may moult there. The waters near Comox on Vancouver Island seem to sustain numerous White-winged Scoters along with those near Bonilla Island and McIntyre Bay in the Queen Charlotte Islands. The limited number of aerial surveys showed the concentrated nature of moulting birds and the discrete nature of moulting sites.

More surveys are needed to define adequately the distribution of moulting seaducks in British Columbia coastal waters. The moult migration of those species is poorly understood and their behaviour and habitat selection during moult has not been studied in British Columbia although some studies have been done elsewhere (Joensen 1973, Gollop et al. 1974). The large numbers of seaducks concentrating along the west coast make the area critical for the survival of those populations. The birds cannot be protected from the impact of human activities unless their requirements are better understood.

LITERATURE CITED

Aldrich, E.C. 1938. A recent oil pollution and its effect on the water birds of San Francisco Bay area. Bird Lore 40:1104-114.

Ankney, C.D. 1979. Does the wing molt cause nutritional stress in Lesser Snow Geese? Auk 96:68-72.

Anweiler, G.G. 1974. Report on summer seabirds along the Fraser delta and Boundary Bay. Unpublished report, Can. Wildl. Serv. Pacific and Yukon Region, Delta, British Columbia.

Bengston, S.-A. 1966. Field studies on the Harlequin Duck in Iceland. Wildfowl Trust 17th annual report: 79-94.

Campbell, R.W. 1964. An annotated list of birds of Mitlenatch Island. Unpublished report. Dept. Recreation and Conservation, Victoria, British Columbia.

Campbell, R.W. and K. Kennedy. 1966. Mitlenatch Island Nature Park summer report. Unpublished report, Dept. Recreation and Conservation, Victoria, British Columbia.

Clapp, R.B., D. Morgan-Jacobs and R.C. Banks. 1982. Marine birds of the southeastern United States and Gulf of Mexico. Part II: Anseriformes. U.S. Fish and Wildl. Service, Office of Biological Services, Washington, D.C. FWS/OBS-82/20.

Douthwaite, R.J. 1976. Weight changes and wing moult in the Red-billed Teal. Wildfowl 27:123-127.

Foottit, R. 1968. Naturalist report for Mitlenatch Island Nature Park. Unpublished report, Department of Recreation and Conservation, Victoria, British Columbia.

Foottit, R. and R. Butler. 1970. Summer naturalist report for Mitlenatch Island Nature Park. Unpublished report, Department of Recreation and Conservation, Victoria, British Columbia.

Gabrielson, I.N. and F.C. Lincoln. 1959. The birds of Alaska. The Stackpole Company and the Wildl. Manage. Institute.

Gollop. M.A., J.R. Goldsberry, R.A. Davis. 1974. Aircraft disturbance to moulting sea ducks, Herschel Island, Yukon Terr., August 1972. In W.W.H. Gunn, W.J. Richardson, R.E. Schweinsburg, and T.D. Wright (eds.); Studies on terrestrial bird populations, moulting sea ducks and bird productivity in the Western Arctic, 1973. Arctic Gas Biol. Rep. Ser. 14(5):202-231.

Guiguet, C.J. 1953. An ecological study of Goose Island, British Columbia with special reference to mammals and birds. British Columbia Provincial Museum. No. 12, occasional paper series.

Hanson, H.C. 1962. The dynamics of condition factors in Canada Geese and their relation to seasonal stresses. Arct. Inst. North Amer. Techn. Paper 12:1-68.

Hatler, D.F., R.W. Campbell and A. Dorst. 1978. Birds of the Pacific Rim National Park. British Columbia Prov. Mus. NO. 20 occasional paper series.

Hay, R.B. 1976. An environmental study on the Kitimat region with special reference to the Kitimat River estuary. Unpublished report, Can. Wildl. Serv., Pacific and Yukon Region, Delta, British Columbia.

Hoffman, D.J. and P.H. Albers. 1984. Evaluation of potential embryotoxicity and teratoginicity of 42 herbicides, insecticides, and petroleum contaminants to mallard eggs. Arch. Environ. Contam. Toxicol. 13:15-21.

Hooper, T.C., K. Vermeer and I. Szabo. 1987. Oil pollution of birds: an annotated bibliography. Technical Report Series No. 34. Canadian Wildlife Service, Pacific and Yukon Region, British Columbia.

Joensen, A.H. 1973. Moult migration and wing feather moult of seaducks in Denmark. Dan. Rev. Game Biol. Vol. 8:42pp.

Joensen, A.H. and E.B. Hansen. 1977. Oil pollution and seabirds in Denmark 1971-1976. Dan. Rev. Game Biol. 10 No. 5. 31pp.

Johnson, S.R., W.J. Adams, M.R. Morrell. 1975. The birds of the Beaufort Sea. Unpublished report. Can. Wildl. Serv., Western and Northern Region, Edmonton, Alberta.

Kennedy, K. and R. Foottit. 1967. Mitlenatch Island Nature Park. Unpublished report, Department of Recreation and Conservation, Victoria, British Columbia.

Kirchhoff, K. 1982. Waterfowl losses caused by fishing at the Baltic coast of Schleswig-Holstein West Germany. Vogelwarte 103:81-89. (In German)

Manuwal, D.A. and R.W. Campbell. 1979. Status and distribution of breeding seabirds of southeastern Alaska, British Columbia and Washington. In J.C. Bartonek and D.N. Nettleship (eds.).

Conservation of marine birds of northern North America. United States Dept. of the Interior. Fish and Wildlife Service. Wildlife Research Report II.

Martin, P.W. 1978. A winter inventory of the shorelines and marine oriented birds and mammals of Chatham Sound. Unpublished report. Can. Wildl. Serv., Pacific and Yukon Region, Delta, British Columbia.

Ohlendorf, H.M., R.L. Hothem, C.M. Bunck, T.W. Aldrich and J.F. Moore. 1986. Relationships between Selenium concentrations and avian reproduction. Trans. 51st N.A. Wildl. and Nat. Res. Conf.

Palmer, R.S. 1962. Handbook of North American birds. Vol. 1. Loons through flamingos. New Haven and London, Yale University Press.

_____. 1976. Handbook of North American birds. Vol. 3. Waterfowl (Part 2). New Haven and London, Yale University Press.

Patch, C.A. 1922. A biological reconnaissance on Graham Island of the Queen Charlotte group. Can. Field-Nat. 36:101-105.

Pehrsson, O. 1987. Effects of body condition on molting in Mallards. Condor 89:329-339.

Piersma, T. 1988a. Breast muscle atrophy and constraints on foraging during the flightless period of wing moulting Great Crested Grebes. Ardea 76:96-106.

Piersma, T. 1988b. The annual moult cycle of Great Crested Grebes. Ardea 76:82-95.

Ross, R.K. 1983. An estimate of the Black Scoter (Melanitta nigra) population moulting in James and Hudson bays. Can. Field-Nat. 97:147-150.

Savard, J.-P.L. 1979. Marine birds of Dixon Entrance, Hecate Strait and Chatham Sound, B.C. during fall 1977 and winter 1978 (number, species, composition and distribution). Regional report, Can. Wildl. Serv., Pacific and Yukon Region, Delta, British Columbia.

Savard, J.-P. L. 1981. Moulting ducks in the coastal waters of British Columbia, a progress report. Regional Report, Can. Wildl. Serv. Pacific and Yukon Region, Delta, British Columbia.

Savard, J.-P. L. 1982. Variability of waterfowl aerial surveys: observer and air-ground comparisons. A preliminary report. Progress Notes No. 127. Can. Wildl. Serv. Ottawa, Ontario.

Savard, J.-P. L. 1985. Fall and winter inventories of Ducks on the Fraser River Delta and Boundary Bay, 1977-1978. Regional Report, Can. Wildl. Serv., Pacific and Yukon Region, Delta, British Columbia.

Smail, J., D.G. Ainley and H. Strong. 1972. Notes on the birds killed in the 1971 San Francisco Bay oil spill. Calif. Birds 3:25-32.

Stott, R.S. and D.P. Olson. 1972. An evaluation of waterfowl surveys on the New Hampshire coastline. J. Wildl. Manage. 36:468-477.

Vauk, G. 1980. Deaths of sea birds following the creeping oil pollution on helgoland West Germany in spring 1979. Vogelwarte 30:271-276. (In German)

Vermeer, K. and G.G. Anweiler. 1975. Oil threat to aquatic birds along the Yukon coast. Wilson Bulletin 87:467-480.

Vermeer, K. and C.D. Levings. 1977. Populations, biomass and food habits of ducks on the Fraser Delta intertidal area, British Columbia. Wildfowl 28:49-60.

Vermeer, R. and K. Vermeer. 1974. Oil pollution of birds. An abstracted bibliography. Pesticide Section, Can. Wildl. Serv. Manuscript Reports No. 29.

Watson, R.M., G.H. Freeman, G.M. Jolly. 1969. Some indoor experiments to simulate problems in aerial censusing. East Afric. Agric. and Forest. Special Issue 1969.

Weller, M.W. 1957. Growth, weights, and plumages of Redhead (Aythya americana). Wilson Bull. 69:5-38.

Young D.A. 1977. Characteristics of the moults in the male Mallard. M.Sc. thesis. Univ. Alberta, Edmonton, Alberta.

Young, D.A. and D.A. Boag. 1982. Changes in physical condition of male Mallards (Anas platyrhynchos) during moult. Can. J. Zool. 60:3220-3226.

Appendix 1. British Columbia Wildlife Record Scheme (BCWRS) data for Harlequin Ducks for the months of July and August.

1.1 July and August BCWRS records of Harlequin Ducks in the Queen Charlotte Islands.

1.2 July and August BCWRS records of Harlequin Ducks along Vancouver Island and the adjacent mainland coast.

1.3 Detailed BCWRS records for Harlequin Ducks.

Legend for figures

group < 50 birds

group 51 - 100 birds

group 101 - 500 birds

group > 500 birds

The enclosed number refers to Appendix 1.3 where the actual sight records are given. Figures 1.1 and 1.2 present only the largest sighting for each location.

Appendix 1.1 July and August BCWRS records of Harlequin Ducks in the Queen Charlotte Islands.

Appendix 1.2 July and August BCWRS records of Harlequin Ducks along Vancouver Island and the adjacent mainland coast.

APPENDIX 1.3. Detailed BCWRS records for Harlequin Ducks.

NO.	LOCATION (MAP GRID)	DATE	NO. OF BIRDS SEEN	COMMENTS
1	TRIANGLE ISLAND (102I/14)	AUG 21/78	21	
		AUG 23/74	12	
		JUL 17/76	10	
		JUL 18/76	12	
		JUL 25/76	11	
		AUG 08/76	16	
		AUG 09/76	13	
		AUG 10/76	13	
		AUG 13/76	13	
		AUG 14/76	11	
		AUG 25/76	11	
		AUG 26/76	14	
		AUG 27/76	13	
		AUG 28/76	14	
		AUG 29/76	20	
		AUG 30/76	14	
		AUG 31/76	10	
		JUL 01/77	13	
		JUL 18/77	14	
		JUL 19/77	10	
		JUL 07/78	17+	
		JUL 10/78	12	
		AUG 13/78	12	
		AUG 20/78	10	
		AUG 22/78	16	
		AUG 23/78	13	
		JUL 12/82	12	
		JUL 13/82	14	
		JUL 14/82	14	
		JUL 17/82	13	
2	HUXLEY ISLAND (103B/6)	JUL 8/77	17	
3	ROCK NW. BOULDER ISLAND (103B/6)	JUL 7/77	31	
4	SEA PIGEON ISLAND (103B/6)	JUL 7/77	14	
5	ALDER ISLAND (103B/6)	JUL 7/77	10	
6	ISLAND FURTHEST E OF SWAN ISL.(103B/6)	JUL 7/77	42	
7	BOULDER ISLAND (103B/6)	JUL 7/77	15	
8	ROCK ISLET (103B/6)	JUL 6/77	16	
9	BOLKUS ISLANDS (103B/6)	JUL 6/77	70	
10	GEORGE ISLAND (103B/6)	JUL 6/77	11	
11	JEFFREY ISLAND (103B/6)	JUL 6/77	20	
12	TAR ISLANDS (103B/6)	JUL 10/77	14	
13	KAWAS ISLETS (103B/6)	JUL 10/77	16	
14	RAMSAY ISLAND (103B/6)	JUL 21/61	20	
		JUL 9/77	13	
15	OFFSHORE HOTSPRINT ISLAND (103B/6)	JUL 8/77	20	
		JUL 7/77	10	
		AUG 15/79	20	
16	FARADAY ISLAND (103B/6)	JUL 8/77	10	
17	RAMSAY ROCK (103B/6)	AUG 9/79	15	

Appendix 1.3 continued, Harlequin Duck

NO.	LOCATION (MAP GRID)	DATE	NO. OF BIRDS SEEN	COMMENTS
18	EAST BISCHOFF ISLANDS (103B/12)	JUL 10/77	33	
19	SHUTTLE PASSAGE (103B/12)	JUL 10/77	21	
20	ISLET SW OF MARCO ISLAND (103B/12)	JUL 8/77	34	
21	SOUTH LAW ISLAND (103B/13)	JUL 11/77	10	
22	GOODEN ISLAND (103F/1)	JUL 17/77	12	
23	ISLAND IN KAGAN BAY (103F/1)	JUL 17/77	63	
		JUL 17/77	14	
24	ISLANDS SE OF GUST ISLAND (103F/1)	JUL 17/77	11	
25	SHINGLE BAY (103G/4)	JUL 14/77	11	
26	CUMSHUWA INLET (103G/4)	JUL 12/77	10	
27	OFFSHORE KUL ROCKS (103B/12)	JUL 10/77	36	
28	1/2MI OFF CHAN.TO MINETTE BAY(103I/2)	JUL 26/75	23	
		JUL 1/75	17	ENTRANCE OF BAY
29	CHATHAM SOUND (103J/7)	JUL 18/69	111	
30	RUSHBROOK PASSAGE (103J/9)	JUL 10/67	40	
		JUL 2/67	10	
		JUL 4/67	26	
		JUL 7/67	31	
		JUL 9/67	10	
		JUL 15/67	10	
		JUL 16/67	10	
31	PORT SIMPSON, BIRNIE IS. (103J/9)	AUG 22/69	14	
32	BOSTON ISLANDS (103J/10)	JUL 6/67	14	
33	NORTH MASSET HARBOUR (103K/1)	JUL 30/77	54	
34	POINT LAZO, COMOX (92F/10)	AUG /43	300	
35	MITLENATCH ISLAND (92F/14)	JUL 5/63	400	
		JUL 01/20	19	
		JUL 25/25	50-60	ALL MALES
		JUL 07/63	150	
		AUG 02/63	20	
		JUL 01/64	100+	
		JUL 04/64	100+	
		JUL 07/64	170±	
		JUL 07/64	150+	
		JUL 09/64	200+	
		JUL 28/64	29+	
		JUL 28/64	20+	
		JUL 30/64	81+	
		AUG 06/64	17	
		AUG 06/64	17	
		AUG 15/64	15+	
		AUG 15/64	15	
		AUG 15/64	15+	
		AUG 20/64	30	
		AUG 20/64	30	
		AUG 20/64	30	
		JUL 07/65	130	
		JUL 19/65	300±	
		AUG 11/65	30+	

Appendix 1.3 continued, Harlequin Duck

NO.	LOCATION (MAP GRID)	DATE	NO. OF BIRDS SEEN	COMMENTS
35	MITLENATCH ISLAND (92F/14)	AUG 11/65	30	
		JUL 06/66	200+	
		JUL 06/66	300	
		JUL 20/66	150+	
		JUL 20/66	150+	
		AUG 12/66	70	
		JUL 01/67	300±	
		JUL 06/68	75	
		JUL 30/68	15	
		AUG 03/68	17	
		JUL 09/69	150	
		JUL 26/69	26	
		AUG 11/69	21	
		AUG 21/69	13	
		JUL 02/70	246±	
		JUL 13/70	77	
		JUL 17/70	80	
		AUG 03/70	22	
		AUG 26/70	14	
		JUL 10/71	150	
		JUL 01/73	61	
		JUL 09/73	35	
		JUL 10/73	202	
		JUL 20/73	33	
		JUL 24/73	11	
		JUL 04/74	87	
		JUL 05/74	80	
		JUL 06/74	100	
		JUL 07/74	50	
		JUL 08/74	40	
		JUL 09/74	10	
		JUL 10/74	10	
		JUL 11/74	10	
		JUL 12/74	95	
		JUL 15/74	14	
		JUL 17/74	158	
		JUL 17/74	158	
		JUL 18/74	85	
		JUL 19/74	30	
		JUL 20/74	30	
		JUL 22/74	30	
		JUL 23/74	20	
		JUL 25/74	22	
		JUL 02/77	127	
		AUG 20/77	30	
		JUL 01/78	119	
36	NORTH GEORGIA STRAIT (92F/14)	JUL 7/77	108+	
		JUL 24/77	35+	

Appendix 1.3 continued, Harlequin Duck

NO.	LOCATION (MAP GRID)	DATE	NO. OF BIRDS SEEN	COMMENTS
37	OYSTER BAY (92F/14)	AUG 16/73	100-150	
		JUL 27/73	50	
		AUG 17/73	100-150	
		AUG 22/73	40±	
		JUL 7/75	10+	
		AUG 24/75	40+	
		JUL 19/76	30+	
		AUG 26/77	10+	
38	SHELTER POINT (92F/14)	JUL 28/76	120	
39	SHELTER BAY (92F/14)	JUL 21/75	220	
		AUG 15/73	50±	
		AUG 26/73	200+	(Males changing from
		JUL 1/74	60+	eclipse to breeding
		JUL 11/74	18	plumage.)
		JUL 29/74	100+	
		AUG 11/74	150+	
		AUG 13/74	100+	
		AUG 18/74	100+	
		AUG 8/75	40+	
		AUG 17/75	60+	
40	CAMPBELL RIVER AREA (92F/14/K3)	AUG 14/21	150+	
		JUL 24/73	50	
		JUL 30/73	30	
		AUG 13/73	125	
		AUG 22/73	40	
		JUL 11/79	30	
41	KWOMAIS POINT (92G/2)	JUL 1/81	41	
		AUG 8/79	26	
42	SNAKE ISLAND (92G/4)	JUL 20/77	40	
43	CANOE ISLET (92G/4)	JUL 15/81	67	
44	OFF MIAMI ISLET (92G/4)	JUL 13/74	32	
		JUL 17/68	15	
45	NANAIMO AREA (92G/4)	AUG 19/74	25	
		JUL 15/74	22	
		JUL 21/74	10	
46	POWELL ISLETS (92K/2)	JUL 2/74	11	
47	SEYMOUR, POYNTZ, MIDGHAM ISLET (92K/5)	JUL 7/75	39	
48	ROBSON BIGHT (92L/7)	AUG 8/82	16	
49	BROKEN ISLANDS (92L/9)	JUL 8/75	11	
50	LEDGE ROCK (92L/10)	JUL 20/75	34	
51	TWIN ISLETS (92L/10)	JUL 19/75	45	
52	ROUND ISLAND (92L/11)	JUL 10/75	31	
53	BUCKLE GROUP (92L/13)	JUL 12/75	13	
54	BROWNING ISLAND (92L/14)	JUL 1/82	21	MOSTLY MALES
55	STAPLES ISLAND (92L/14)	JUL 18/75	52	
		JUL 19/75	13	
56	OMMANEY ISLETS (92L/15)	AUG 30/67	10	
57	STORM ISLANDS (92M/4)	JUL 17/75	100	
58	DARBY CHANNEL (92M/12)	AUG 8/77	79	

Appendix 1.3 continued, Harlequin Duck

NO.	LOCATION (MAP GRID)	DATE	NO. OF BIRDS SEEN	COMMENTS
59	KOEYE RIVER MOUTH (92M/13)	AUG 25/48	12	
60	FLORENCIA ISLAND (92C/13)	JUL 11/75	11	
61	BAERIA ROCKS (92C/14)	AUG 30/77	14	
		JUL 17/75	12	
62	VILLAGE REEF (92C/14)	JUL 15/75	40	
		JUL 13/75	40	
63	PINDER ROCK (92C/14)	JUL 14/75	44	
64	IMPERIAL EAGLE CHANNEL (92C/14)	JUL 25/70	38	
65	GREAT BEAR ROCK (92C/14)	AUG 18/76	34	
		AUG 19/77	12	
		AUG 30/77	23	
66	CLELAND ISLAND (92E/1)	JUL 23/76	24+	
		AUG 28/67	17	
		JUL 12/76	20	
		JUL /78	10	JULY 15 AND 16
		JUL 24/82	20±	
67	QUALICUM BEACH AREA (92F/8)	AUG 10/75	51	
		JUL 02/73	12	
		JUL 05/73	12	
		JUL 06/73	10	
		JUL 07/73	35+	
		JUL 09/73	25	
		JUL 10/73	20	
		JUL 12/73	12	
		JUL 13/73	28	
		JUL 15/73	50	
		JUL 16/73	25	
		AUG 01/73	14	
		AUG 12/73	29	
		AUG 15/73	22	
		AUG 16/73	40	
		AUG 17/73	22	
		AUG 18/73	22	
		AUG 22/73	20	
		AUG 24/73	21	
		AUG 26/73	40	
		AUG 27/73	34	
		JUL 02/74	21	
		JUL 03/74	32	
		JUL 04/74	21	
		JUL 07/74	15	
		JUL 09/74	32	
		JUL 11/74	16	
		JUL 12/74	12	
		JUL 18/74	17	
		JUL 22/74	17	
		JUL 24/74	15	
		JUL 27/74	34	
		JUL 28/74	25	

Appendix 1.3 continued, Harlequin Duck

NO.	LOCATION (MAP GRID)	DATE	NO. OF BIRDS SEEN	COMMENTS
67	QUALICUM BEACH AREA	AUG 02/74	14	
		AUG 06/74	51	
		AUG 10/74	21	
		AUG 13/74	30	
		AUG 14/74	44	
		AUG 16/74	24	
		AUG 18/74	14	
		AUG 20/74	35	
		AUG 23/74	22	
		AUG 24/74	34	
		AUG 28/74	21	
		JUL 01/75	12	
		JUL 06/75	14	
		JUL 10/75	44	
		JUL 11/75	14	
		JUL 15/75	10	
		JUL 16/75	19	
		JUL 18/75	23	
		JUL 20/75	20	
		JUL 25/75	24	
		JUL 27/75	46	
		JUL 29/75	21	
		AUG 02/75	19	
		AUG 03/75	22	
		AUG 06/75	14	
		AUG 12/75	10	
		AUG 13/75	15	
		AUG 15/75	15	
		AUG 17/75	38	
		AUG 19/75	17	
		AUG 20/75	41	
		AUG 21/75	11	
		AUG 23/75	14	
		AUG 24/75	23	
		AUG 24/75	18	
		AUG 26/75	12	
		AUG 28/75	15	
		JUL 31/76	10	
		JUL 01/77	34	
		JUL 03/77	17	
		JUL 05/77	22	
		JUL 09/77	16	
		JUL 10/77	18	
		JUL 13/77	17	
		JUL 14/77	14	
		JUL 15/77	17	
		JUL 16/77	19	
		JUL 17/77	11	
		JUL 20/77	12	

Appendix 1.3 continued, Harlequin Duck

NO.	LOCATION (MAP GRID)	DATE	NO. OF BIRDS SEEN	COMMENTS
67	QUALICUM BEACH AREA	JUL 21/77	20	
		JUL 28/77	27	
		JUL 29/77	14	
		AUG 09/77	10	
		AUG 12/77	23	
		AUG 15/77	32	
		AUG 23/77	11	
		AUG 24/77	12	
		AUG 28/77	18	
		AUG 29/77	13	
		AUG 30/77	14	
		AUG 31/77	13	
		JUL 08/78	11	
		JUL 10/78	12	
		JUL 16/78	11	
		JUL 31/78	18	
		AUG 01/78	12	
		AUG 22/78	14	
		AUG 26/78	10	
68	MANDARTE ISLAND (92B/11)	JUL 19/61	50	
		JUL 8/61	50	
		AUG 19/70	12	
		JUL 21/76	20	
69	CLOVER POINT (92B/6)	JUL 2/75	27	
		JUL 1/85	17	
		AUG 1/77	14	
		JUL 3/78	24	TO WILLOWS BEACH
		JUL 1/79	13	
		JUL 5/80	15	
		JUL 1/84	11	
70	CHAIN ISLETS (92B/6)	JUL 19/76	110	
		JUL 25/73	16	
		AUG 3/73	20	
		AUG 9/75	15	
71	BALLINGAL ISLAND (92B/14)	AUG 4/79	71	FLIGHTLESS
		JUL 27/76	19	
72	HORNBY ISLAND, HELLIWELL PARK (92F/10)	JUL 1/77	120	FLORA ISLET
		JUL 29/78	24	PHIPPS POINT
		AUG 12/78	83	
		AUG 28/78	84	
73	COMOX BAY (92F/10)	JUL 1922		LARGE FLOCK
		JUL 21/22		FLOCK
74	SEAL ISLET (92F/10)	AUG 2/22		GREAT NUMBER
75	CAPE LAZO (92F/10)	AUG 24/63	150	
		AUG 31/22		LARGE FLOCK
76	SISTERS ISLETS (92F/8)	AUG 16/74	50	
77	MAPLEWOOD FLATS (92G/6)	JUL 4/81	70	
		AUG 26/81	50	
78	GILLATT ISLAND (103G/4)	JUL 14/77	41	

Appendix 1.3 continued, Harlequin Duck

NO.	LOCATION (MAP GRID)	DATE	NO. OF BIRDS SEEN	COMMENTS
79	GREEN ISLAND, CHATHAM SOUND (103J/10)	JUL 4/78	50+	
80	WEST McINTYRE BAY (103K/1)	JUL 30/77	156	
81	CRESCENT BEACH (92G/2)	JUL 21/86	30	
82	BROOKS PENINSULA (92L/4)	AUG 4-15/81	20±	
85	PAM ROCKS (92G/6)	AUG 11/77	48	MOSTLY MOLTING BIRDS
86	MIRACLE BEACH PARK (92F/14)	AUG 22/74	35+	
		AUG /60	12	
		AUG 9/65	20	
88	ROSE ISLETS (92G/4)	JUL 13/74	16	
89	REEFS W. OFF TRAIL ISLANDS (92G/5)	AUG 8/79	50	
90	OAK BAY GOLF COURSE (92B/6)	AUG 1/77	38	
		JUL 24/50	20+	
		JUL 25/75	15	
		AUG 6/75	16	
		AUG 9/75	27	
		JUL 13/76	20	
		AUG 30/76	17	
		AUG 23/77	12	
		AUG 11/78	15	
		AUG 20/78	13	
		AUG 31/80	19	
		AUG 18/81	14	
92	STORIES BEACH (92F/14)	AUG 8/74	50+	
		JUL 15/74	13	
		JUL 15/75	30+	
		JUL 16/75	30+	
		JUL 31/75	30+	
		AUG 01/75	30+	
		AUG 02/75	30+	
		AUG 15/75	30+	
		AUG 16/75	11	
		AUG 31/75	15	
93	MASSET SOUND ENTRY POINT (103K/1)	JUL 7/83	15	
94	ROSS BAY (92B/6)	JUL 1/81	33	
		JUL 1/79	12	
95	OAK BAY (92B/6)	JUL 5/80	66	
		JUL 10/52		VERY NUMEROUS
		JUL 27/74	18	McMICKING POINT
		JUL 12/75	25	E END OF McNEILL BAY
		JUL 19/78	10	McMICKING POINT
		JUL 5/80	47	MARINA
		JUL 3/81	13	CATTLE POINT

Appendix 2. British Columbia Wildlife Record Scheme (BCWRS) data for Surf Scoters for the months of July and August.

2.1 July and August BCWRS records of Surf Scoters in the Queen Charlotte Islands.

2.2 July and August BCWRS records of Surf Scoters along Vancouver Island and the adjacent mainland coast.

2.3 Detailed BCWRS records for Surf Scoters.

Legend for figures

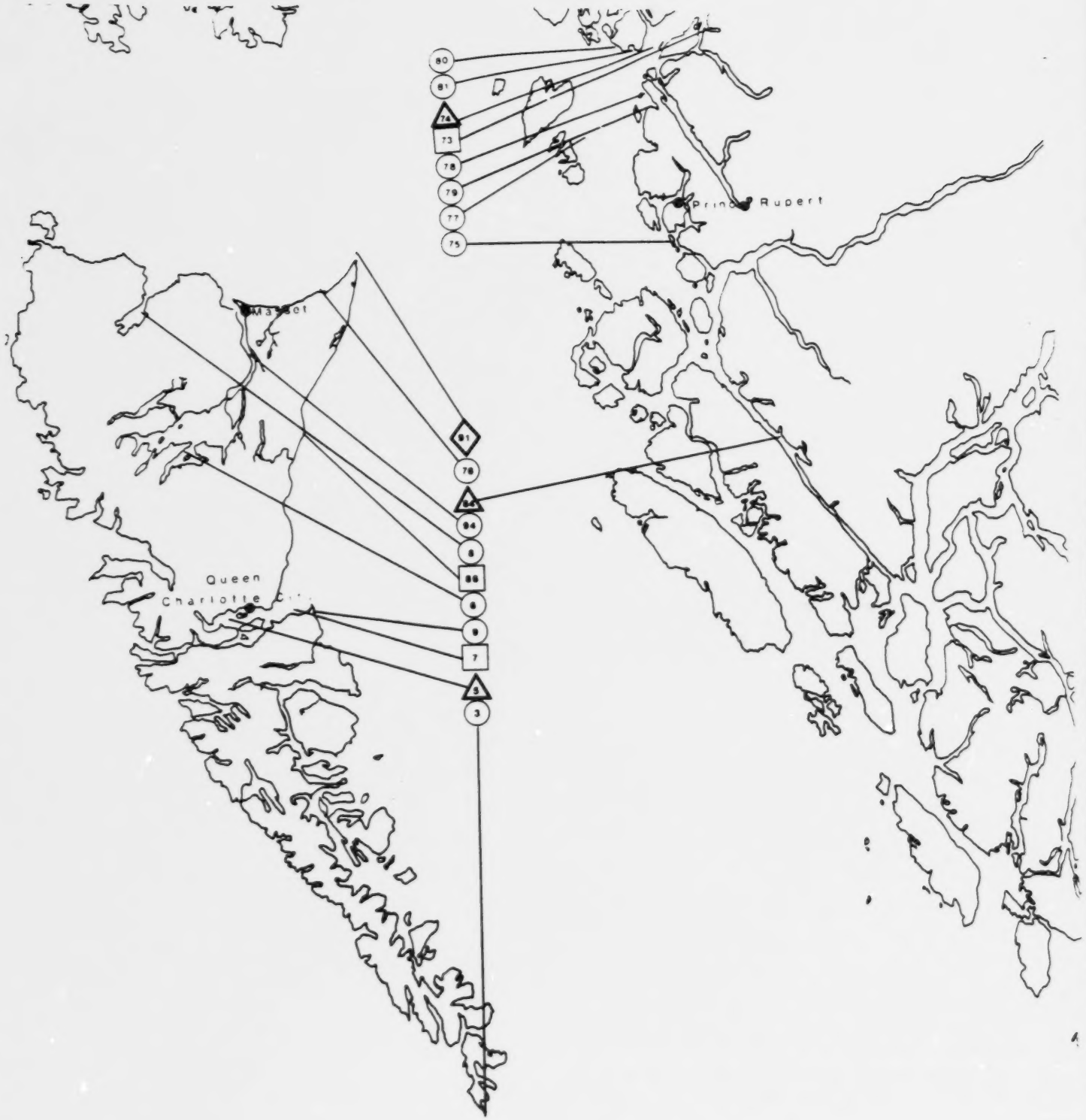
group < 50 birds

group 51 - 100 birds

group 101 - 500 birds

group > 500 birds

The enclosed number refers to Appendix 2.3 where the actual sight records are given. Figures 2.1 and 2.2 present only the largest sighting for each location.



Appendix 2.1 July and August BCWRS records of Surf Scoters in the Queen Charlotte Islands.

Appendix 2.2 July and August BCWRS records of Surf Scoters along Vancouver Island and the adjacent mainland coast.

APPENDIX 2.3. Detailed BCWRS records for Surf Scoters.

NO.	LOCATION (MAP GRID)	DATE	NO. OF BIRDS SEEN	COMMENTS
1	BROWNING INLET, GRANT BAY (102I/8)	JUL ?/68	15	WINTER HARBOUR
2	SOUTH BAY, TRIANGLE ISLAND (102I/14)	JUL 11/78	11	
3	OFF SOUTH CAPE SAINT JAMES (102O/14)	AUG 10/81	10	
4	TROUP PASSAGE (103A/1)	AUG 14/68	32	
		JUL 21/68	11	
		AUG 10/68	30	
		AUG 11/68	29	
		AUG 12/68	20	
		AUG 15/68	23	
		AUG 17/68	29	
		AUG 18/68	13	
5	ISLANDS IN KAGAN BAY (103F/1)	JUL 17/77	162	NEAR SLATECHUCK CRK.
6	OHALA ISLETS (103F/9)	JUL 31/77	11	
7	SOUTH SKIDEGATE INLET (103F/1)	JUL 19/77	100	
8	NADEN HARBOUR (103F/15)	AUG 29/84	30	
9	SANDSPIT (103G/5)	AUG /77	20	AUG 13 & 14 COMBINED
		AUG 4/79	20	
10	WITTY BEACH AREA (92B/5)	AUG 2/76	40	
		JUL 10/71	16	
	(92B/6)	AUG 20/75	16	
		JUL 27/74	20	
		JUL 1/76	10	
		AUG 8/76	14	
		AUG 29/76	20	
		AUG 1/81	12	
		AUG 27/81	35	
		AUG 27/83	20	
11	MT. DOUGLAS PARK (92B/6)	JUL 5/80	80	
		AUG 26/73	20+/-	BEACH AREA
		JUL 25/74	15	BEACH AREA
		JUL 28/74	30	
		JUL 24/77	40	
		JUL 28/77	30	
		JUL 30/84	15	
12	TRIAL ISLAND (92B/6)	JUL 22/55	30+/-	
		JUL 19/78	13	McMICKING POINT
13	ISLAND VIEW (92B/11)	JUL 2/84	50	
		JUL 10/74	35	
		JUL 28/79	15	
		JUL 5/80	25	
		JUL 22/82	38	
		AUG 2/82	49	
		AUG 26/83	45	
14	COWICHAN HEAD (92B/11)	JUL 22/82	57	
15	BOATSWAIN BANK (92B/12)	JUL 15/81	15	
		JUL 16/75	35	
		AUG 28/76	30	
		AUG 29/76	20	
		JUL 12/83	45	

Appendix 2.3 continued, Surf Scoter

NO.	LOCATION (MAP GRID)	DATE	NO. OF BIRDS SEEN	COMMENTS
16	SATELLITE CHANNEL (92B/11)	AUG 10/72	150	
	(92B/12??)	JUL 15/74	77	
17	BALLINGAL INLETS (92B/14)	JUL 27/76	23	
18	PACHENA BAY (92C/14)	AUG 21/77	500	
		AUG 20/76	183	SCATTERED
		AUG 17/77	100	
		AUG 18/77	100	
		AUG 25/77	500	
		JUL 2-20/79	206	
19	SIDNEY ISLAND (92B/11)	JUL 1/78	69	WEST SHORE
		JUL 1/53	55	
20	BAZEN BAY (92B/11)	AUG 21/82	23	
		JUL 24/76	22	
21	CLOVER POINT (92B/6)	JUL 2/76	23	
		AUG 24/73	10	
		JUL 20/78	11	
		AUG 8/81	11	
		JUL 3/83	19	ALSO OFF VIC. GOLF C
		JUL 17/83	12	
		JUL 19/83	22	
		JUL 2/84	12	
22	OAK BAY GOLF COURSE (92B/6)	JUL 12/80	13	
22	OAK BAY	JUL 10/52		GROUPS OF 10 TO 12
23	SIDNEY SPIT (92B/11)	JUL 1/78	53	
24	MINERS CHANNEL (92B/11)	AUG 21/82	63	
25	OFF CORDOVA SPIT, C. SAANICH (92B/11)	AUG 10/77	63	FLYING
26	KUPER ISLAND (92B/13)	JUL 13/74	63	
27	TRINCOMALI CHANNEL (92B/13)	JUL 7/36	40	
28	ENTRANCE TO MAYNE ISLAND (92B/14)	AUG 6/69	26	
29	CORDOVA BAY (92B/6)	AUG 12/83	33	
30	MANDARTE ISLAND (92B/11)	JUL /61	12	Jul 8 & 9 COMBINED
31	OFF CAPE BEALE (92C/14)	AUG 11/68	150	
		AUG 22/64	20±	
		JUL 30/70	25	
32	ROCK HD 2MI SE OF JORDAN RIVER(92C/8)	AUG 30/74	150	
33	FLORENCIA BAY (92C/13)	AUG 2/74	425	
		AUG 4/74	58	
34	BARKLEY SOUND (92C/14)	AUG 19/68	500+	
		AUG 16/78	30	N.W. ISLANDS IN SD.
		AUG 10/64	20	
35	FROM BAMFIELD TO BAERIA ROCKS (92C/14)	AUG 17/76	70	
36	TREVOR CHANNEL AREA (92C/14)	AUG 17/76	64	
		AUG 16/76	16	
37	BAMFIELD TO CLELAND ISLAND (92C/14)	AUG 31/76	110	
38	CLELAND ISLAND (92E/1)	JUL 24/67	30	
		AUG 31/69	21	
39	STUBBS ISLAND (92F/4)	JUL 16/60	25-30	

Appendix 2.3 continued, Surf Scoter

NO.	LOCATION (MAP GRID)	DATE	NO. OF BIRDS SEEN	COMMENTS
40	MITLENATCH ISLAND (92F/14)	JUL 13/64	57	
		JUL 16/27		MIGRATING FLOCKS
		JUL 06/63	14	
		JUL 09/63	15	
		JUL 10/63	21	
		JUL 15/63	12	
		JUL 15/63	18	
		JUL 17/63	13	
		JUL 20/63	12	
		JUL 22/63	16	
		JUL 24/63	24	
		AUG 02/63	16	
		JUL 01/64	17	
		JUL 27/64	32	
		JUL 29/64	32	
		AUG 01/64	35	
		AUG 02/64	40+	
		AUG 11/64	25	
		AUG 15/64	20+	
		JUL 02/65	15	
		JUL 04/65	30	
		JUL 05/65	20+	
		AUG 04/65	20+	
		AUG 24/65	35	
		AUG 06/66	25	
		AUG 07/68	16	
		AUG 08/68	24	
		AUG 25/68	10	
		JUL 14/69	17	
		JUL 15/69	55	
		JUL 23/69	13	
		AUG 02/69	30	
		AUG 10/69	30	
		AUG 30/69	22	
		JUL 26/70	20	
		AUG 06/70	25	
		AUG 26/70	25	
		JUL 04/74	13	
		JUL 27/74	36	
		AUG 14/76	21	
41	HERNANDO ISLAND (92F/15)	AUG 11/69	1000	80% UNABLE TO FLY
		JUL 31/74	37	
		JUL 9/73	84	
42	CAPE LAZO, COMOX (92F/10)	JUL 11/50	285	
43	LONG BEACH (92F/4)	JUL 31/70	200	
		JUL 16/83	66	
44	QUALICUM (92F/8)	JUL 15/73	61	
		JUL 07/73	12	
		JUL 08/73	11	

Appendix 2.3 continued, Surf Scoter

NO.	LOCATION (MAP GRID)	DATE	NO. OF BIRDS SEEN	COMMENTS
44	QUALICUM (92F/8)	JUL 09/73	40	
		JUL 12/73	11	
		JUL 13/73	10	
		JUL 14/73	20	
		JUL 16/73	34	
		AUG 02/73	14	
		AUG 03/73	18	
		AUG 04/73	21	
		AUG 07/73	18	
		AUG 08/73	25	
		AUG 09/73	20	
		AUG 10/73	20	
		AUG 11/73	24	
		AUG 12/73	26	
		AUG 14/73	17	
		AUG 15/73	20	
		AUG 16/73	24	
		AUG 17/73	30	
		AUG 17/73	23	
		AUG 22/73	17	
		AUG 23/73	23	
		AUG 24/73	30	
		AUG 25/73	25	
		AUG 26/73	25	
		AUG 27/73	31	
		JUL 12/74	15	
		JUL 13/74	12	
		AUG 11/74	17	
		AUG 28/74	12	
		AUG 30/74	52	
		AUG 31/74	25	
		JUL 01/75	11	
		JUL 20/75	16	
		JUL 22/75	10	
		AUG 14/75	60+/-	
		JUL 09/77	10	
		JUL 21/77	25+/-	
		JUL 10/78	10	
		AUG 13/78	12	
		AUG 16/78	12	
		AUG 13/84	16	
45	SEAL ILS. (92F/10)	JUL 19/22		CONSIDERABLE FLOCKS
46	COMOX BAY (92F/10)	JUL 17/22		GREAT FLOCKS
		JUL 18/22		LOTS
		JUL 12/22		SMALL FLOCKS
				TREE IS.-COMOX BAY
47	UNION BAY (92F/10)	AUG 19/74	20	
48	GOOSE SPIT, COMOX (92F/10)	AUG 25/73	80+/-	

Appendix 2.3 continued, Surf Scoter

NO.	LOCATION (MAP GRID)	DATE	NO. OF BIRDS SEEN	COMMENTS
49	ELMA BAY (92F/14)	JUL 1/38	300	
		JUL 1/31		SEVERAL LOTS 'GOING SOUTH'
		JUL 19/31	200	
		AUG 14/31	200+/-	
		JUL 9/33		QUITE A LOT
		JUL 12/35	50	50 MALES
50	OYSTER BAY (92F/14)	AUG 22/73	50	
		AUG 26/73	50+/-	
		AUG 31/75	21	
51	MIRACLE BEACH (92F/14)	AUG 29/74	35	
		AUG 8/74	25	
52	SHELTER POINT (92F/14)	AUG 10/75	10+	
53	CAMPBELL RIVER AREA (92F/14-K3)	AUG 22/73	50	
54	BLUBBER BAY, TEXADA ISLAND (92F/15)	JUL 24/21	11	
55	LANG BAY AND BREW BAY (92F/16)	AUG 21/81	35	
56	TSAWASSEN FERRY TERMINAL (92G/3)	JUL 29/73	600+/-	
		AUG 27/60	16	
57	OFF MIAMI ISLET (92G/4)	JUL 17/68	500	
		JUL 13/74	18	
58	PAM ROCKS (92G/6)	AUG 8/79	500	
		JUL 25/76	143	
59	CHRISTIE ISLET (92G/11)	AUG 11/77	800	MOULTING SUBADULTS
60	PROTECTION ISLAND (92G/4)	AUG 14/76	100	
61	NANAIMO AREA (92G/4)	AUG 25/74	25	
62	STANLEY PARK (92G/6)	JUL 4/59	20	
63	HOWE SOUND (92G/11)	JUL 31/71	107	
64	SQUAMISH (92G/11)	AUG 27/68	35	
65	CRESCENT BEACH (92G/2)	JUL 25/42	100	
		JUL 14/42	50	
		AUG 6/42	25	
		AUG 29/42	25	
		JUL 31/49	12	
66	KWOMAIS POINT (92G/2)	AUG 8/79	13	
67	WHITE ROCK PIER (92G/2)	AUG 6/79	70	
68	CANOE PASS (92G/3)	JUL 18/59	20	
69	EGG ROCKS (92M/4)	JUL 9/68	18	
70	DARBY CHANNEL (92M/12)	AUG 8/77	157	
71	RIVERS INLET (92M/12)	AUG 8/77	80	
72	FITZHUGH SOUND (92M/13-14)	JUL 15/39		FLOCKS
73	DWINAMASS BAY (103J/16)	JUL 12/67	100	
74	PORTLAND INLET (103J/16)	JUL 21/66	200+	
		JUL 20/66	30	
	(103J/9)	JUL 19/67	200	
75	RIDLEY ISLAND (103J/1)	JUL 3/79	12	
76	YAKAN POINT, Q.C.I. (103J/4)	AUG 19/74	43	
		AUG 14/74	26	
77	CHATHAM SOUND (103J/7,10)	JUL 9/67	10	

Appendix 2.3 continued, Sur Scoter

NO.	LOCATION (MAP GRID)	DATE	NO. OF BIRDS SEEN	COMMENTS
78	RUSHBROOK PASSAGE 103J/9)	JUL 15/67	31	
		JUL 4/67	10	
		JUL 7/67	16	
		JUL 10/67	10	
		JUL 12/67	29	
		JUL 13/67	20	
		JUL 17/67	15	
79	PORT SIMPSON (103J/9)	JUL 8/67	42	
		AUG 12/69	30	
		AUG 15/69	11	
80	BOSTON ISLANDS (103J/10)	JUL 6/67	14	
82	COSTE ISLAND ROCK, DOUGLAS CH.(103H/15)	JUL 4/75	800+/-	MOSTLY MALES
		JUL 2/75	800+/-	MOSTLY MALES
83	DEVASTATION REACH (103H/10)	JUL 4/77	30	
		JUL 4/75	45+/-	SOUTH END DOROTHY IS
84	GRENVILLE CHANNEL (103H/6,1)	JUL 15/69	2161	
		JUL 20/67	78	
86	CAPE BALL, Q.C.I. (103G/12)	AUG 2/74	52	
87	WEST SIDE OF VARGAS ISLAND (92E/1)	AUG 10/61	3-4000	MIXED WITH WWSC
88	NORTH SIDE OF VARGAS ISLAND (92E/1)	AUG 11/61	10	IN FLIGHT
89	HESQUIAT HARBOUR (92E/8)	AUG 12/72	300	
90	FLORES ISLAND (92E/8)	AUG 9/61	15	
91	ROSE SPIT (103J/4)	JUL 15/77	1000+	OFFSHORE
92	NEAR W. SIDE OF SHUSHARTIE BAY (92L/13)	AUG 28/67	30	
93	BROOKS PENINSULA (92L/4)	AUG 4-15/	30+/- max	
94	MASSET SOUND, Q.C.I. (103K/1)	JUL 7/85	50	
95	NEAR MAUDE ISLAND (92K/3)	AUG 6/69	15	
96	PORT NEVILLE INLET (92K/2)	JUL 24/76	15	
97	SNAKE ISLAND (92G/4)	JUL 15/81	20	
98	ROSE ISLETS (92G/4)	JUL 13/74	22	
		JUL 15/81	15	

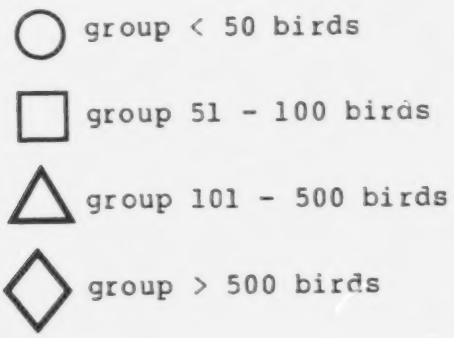
Appendix 3. British Columbia Wildlife Record Scheme (BCWRS) for White-winged Scoters for the months of July and August.

3.1 July and August BCWRS records of White-winged Scoters in the Queen Charlotte Islands.

3.2 July and August BCWRS records of White-winged Scoters along Vancouver Island and the adjacent mainland coast.

3.3 Detailed BCWRS records for White-winged Scoters.

Legend for figures



The enclosed number refers to Appendix 3.3 where the actual sight records are given. Figures 3.1 and 3.2 present only the largest sighting for each location.

Appendix 3.1 July and August BCWRS records of White-winged Scoters in the Queen Charlotte Islands.

Appendix 3.2 July and August BCWRS records of White-winged Scoters along Vancouver Island and the adjacent mainland coast.

APPENDIX 3.3. Detailed BCWRS records for White-winged Scoters.

NO.	LOCATION (MAP GRID)	DATE	NO. OF BIRDS SEEN	COMMENTS
1	KWOMAIS POINT (92G/2)	JUL 26/80	30	
2	CRESCENT BEACH (92G/2)	AUG 25/68	12	
3	SQUAMISH (92G/11)	AUG 27/68	40	MOUTH OF CHEAKAMUS R
4	SEMIAMHOO BAY & INDIAN RESERVE (92G/2	AUG 29/79	40	
5	TSAWASSEN FERRY TERMINAL (92G/3)	JUL 29/73	10	
6	IONA (92G/3)	JUL 2/73	15	
7	BEACH GROVE (92G/3)	JUL 30/81	50	
8	MIAMI ISLETS (92G/4)	JUL 17/68	100	
9	MAPLEWOOD FLATS (92G/6)	JUL 10/81	50	
10	PORT NEVILLE (92L/9)	JUL 5/75	34	
11	ALERT BAY (92L/10)	JUL 1/69	12	
		AUG 9-15/17		SEVERAL
12	PORT HARDY (92L/11)	AUG 9/78	100	KEOGH RIVER
13	CLUXEWE RIVER (92L/11)	AUG 8/81	12	
14	KYE BAY (92F/10)	JUL 8/36		MANY
		AUG 2/35		SEVERAL STRINGS
15	DENMAN SPIT (92F/10)	JUL 1/28	150	
16	BAYNES SOUND (92F/10)	JUL 10/50	50	
17	SEAL ILS. (92F/10)	JUL 19/22		CONSIDERABLE FLOCKS
		AUG 7/22		FLOCK
18	LANG BAY & BREW BAY (92F/10)	AUG 21/81	57	
19	ROYSTON (92F/10)	AUG 20/27	1000	
20	MITTLENATCH ISL. (92F/14)	JUL 12/67	26	
		AUG 18/68	20	
21	ELMA BAY (92F/14)	JUL 12/35	25	
22	COMOX (92F/10)	AUG END/54	2000±	
		AUG 5/41	20	
		JUL 2/22		PROBABLY 1000±
		JUL 5/22		NOT QUITE AS ABOVE
		JUL 18/22		LOTS
		AUG 2/22		LARGE NUMBERS
		JUL 12/22		TREE IS - COMOX BAY
				GREAT FLOCKS
23	MIRACLE BEACH PARK (92F/14)	AUG 24/30		NUMEROUS; OYSTER RIVE
24	OYSTER BAY (92F/14)	AUG 30/75	26+	
25	GEORGIA STRAIT (92F/14)	AUG 17/75	51	
26	BETWEEN HERNANDO & SAVARY IS.(92F/15)	JUL 2/70	200	
27	QUALICUM (92F/3)	JUL 3/78	100±	
		JUL 6/63	10	
		JUL 7/63	30	
		JUL 1/75	55 & 12	
		JUL 2/75	15	
		JUL 17/75	16	
		JUL 12/77	33	
		JUL 14/77	28	
		JUL 15/77	17	
		JUL 18/77	18	
		JUL 21/77	40	

Appendix 3.3 continued, White-winged Scoter

NO.	LOCATION (MAP GRID)	DATE	NO. OF BIRDS SEEN	COMMENTS
27	QUALICUM (92F/8)	JUL 22/77	25	
		JUL 24/77	15	
		JUL 26/77	17	
		AUG 1/77	12	
		AUG 4/77	10	
		AUG 10/77	100+	
		JUL 8/78	18	
		JUL 14/78	12	
		AUG 6/78	10	
		AUG 24/78	12	
29	BROWNING INLET, GRANT BAY (102I/8)	JUL ?/68	15	
30	SPIDER I. (102P/16)	JUL 12/39		FLOCKS
31	SKINCUTTLE INLET (103B/6)	JUL 7/77	39	
32	HOUSTON POINT (103B/6)	JUL 7/77	32	
33	SLUG ISLAND (103B/6)	JUL 6/77	23	
34	EAST SKIDEGATE CHANNEL (103F/1)	JUL 18/77	26	
35	DYER POINT AND ADJ. ROCKS (103F/1)	JUL 17/77	286	
36	TREBLE ISLAND (103F/1)	JUL 17/77	13	
37	SCALUS ISLAND (103F/1)	JUL 17/77	14	
38	KAGAN BAY (103F/1)	AUG 5/79	300	
39	CHALA ISLETS (103F/9)	JUL 31/77	48	
40	SHINGLE BAY (103G/4)	JUL 14/77	51	
41	SKEDANS TO SANDSPIT (103G/4)	JUL 12/77	97	IN SMALL FLOCKS
42	CUMSHEWA ISLAND (103G/4)	JUL 12/77	10	
43	CUMSHEWA INLET (103G/4)	JUL 12/77	48	
44	SANDSPIT (103G/4)	AUG 25/79	200±	
		JUL 3/77	17	
		AUG /77	100	AUG 13 & 14 COMBINED
		AUG 28/78	60	
		AUG 4/79	50	
		AUG 22/81	45	
	(103G/5)	AUG /77	100	AUG 13 & 14 COMBINED
46	DAVEY ISLETS (103G/4)	JUL 12/77	100	
47	SKIDEGATE MISSION (103G/5)	AUG 5/79	40	
48	OFF TLELL, Q.C.I. (103G/12)	JUL 31/77	140	
		JUL 27/74	31	
		AUG 25/74	25	
49	CAPE BALL, Q.C.I. (103G/12)	AUG 2/74	240	
50	OEANDA RIVER MOUTH (103G/13)	AUG 1/74	34	
51	EAGLE CREEK, Q.C.I.(103G/13)	AUG 2/74	48	
52	GIBSON ISLAND (103H/16)	JUL 4/76	28	N. GRANVILLE CHANNEL
53	GRENVILLE CHANNEL (103H/6,12)	JUL 16/69	28	
54	COSTE ROCKS-DOUGLAS CHANNEL (103H/15)	JUL 4/75	40	
55	ROSE SPIT (103J/4)	JUL 15/77	200+	
		AUG 20/74	55	
		AUG 21/74	25	
		JUL 15/77	54	
		JUL 31/77	97	

Appendix 3.3 continued, White-winged Scoter

NO.	LOCATION (MAP GRID)	DATE	NO. OF BIRDS SEEN	COMMENTS
56	TOWHILL, Q.C.I. (103J/4)	JUL 14/77	1000+	
		JUL 15/74	34	
		JUL 16/74	25	
		AUG 14/74	14	
		AUG 21/74	12	
57	KUMARA LAKE AT SEA (103J/4)	AUG 19/74	155	
		JUL 31/74	56	
58	YAKAN POINT, Q.C.I. (103J/4)	AUG 13/74	65	
		AUG 14/74	14	
		AUG 19/74	32	
59	RUSHBROOK PASSAGE (103J/9)	JUL 10/67	12	
60	PORT SIMPSON - BIRNIE ISL. (103J/9)	AUG 22/69	12	
61	PORT SIMPSON (103J/9)	AUG 20/69	34	GOVERNMENT WHARF
		AUG 22/69	22	STUMAN BAY
		AUG 19/69	27	HARBOUR REEFS
		AUG 26/69	16	
62	W. McINTRYE BAY (103K/1)	JUL 30/77	187	
63	S. LANGARA ISLAND (103K/2)	JUL 27/77	14	
64	PORT RENFREW (92C/9)	JUL 12/70	40	
65	FLORENCIA BAY (92C/13)	AUG 2/74	55	
		JUL 15/74		HUNDREDS; WRECK BAY
		AUG 4/74	12	
		JUL 13/83	15	
66	IMPERIAL EAGLE CHANNEL (92C/14)	JUL 10/73	70±	
67	BARKLEY SOUND (92C/14)	AUG 3/68	2000±	
68	OFF CAPE BEALE (92C/14)	AUG 9/68	600±	
		JUL 16/75	20	
69	PACHENA BAY (92C/14)	AUG 18/77	50	
		AUG 20/76	21	
		JUL 2-20/79	40±	
70	CLELAND ISLAND (92E/1)	JUL 24/67	20	
71	WEST SIDE OF VARGAS ISLAND (92E/1)	AUG 10/61	3-4000	
72	NANOOSE BAY (92F/1,8)	JUL 10/50	165	
73	OFF TOFINO (92F/4)	JUL 29/72	14	
74	STUBBS ISLAND (92F/4)	JUL 31/61		SMALL FLOCKS
75	LONG BEACH, V.I. (92F/4)	AUG 28/62	10	
76	UCLUELET TO TOFINO (92F/4)	AUG 2/74	42	
77	SHIP'S POINT MUD BAY V.I. (92F/7)	AUG 30/62	24	
78	CLOVER POINT (92B/6)	JUL 4/83	24	
		JUL 6/78	22	
		JUL 12/78	19	
		JUL 17/83	14	
79	GOLF LINKS POINT (92B/6)	JUL 5/78	93	FLYING
		AUG 26/43	15	OAK BAY N. OF MARINA
		JUL 19/75	16	
		JUL 19/75	17	SW. OFF CATTLE POINT
		AUG 26/75	15	HARLING PT. OAK BAY
		JUL 10/78	38	

Appendix 3.3 continued, White-winged Scoter

NO.	LOCATION (MAP GRID)	DATE	NO. OF BIRDS SEEN	COMMENTS
80	ISLAND VIEW (92B/11)	JUL 14/75	71	
		JUL 1/75	46	
		AUG 16/75	23	
		JUL 28/79	19	
81	PATRICIA BAY, SAANICH INLET (92B/11)	JUL 21/76	15	
82	MT DOUGLAS BEACH (92B/6)	JUL 25/74	60	
		JUL 28/74	10	
		AUG 11/81	17	
83	SOUTH OFF GONZALES POINT (92B/6)	JUL 14/74	50	
84	ESQUIMALT LAGOON (92B/6)	JUL 2/73	10	
85	ROYAL ROADS (92B/6)	AUG 30/80	40	
		JUL 10/81	11	
		AUG 13/81	15	
		AUG 31/81	26	
86	FINLAYSON ARM (92B/12)	JUL 15/51	75	
87	BOATSWAIN BANK (92B/12)	JUL 22/83	180	
		JUL 29/74	50	
		JUL 16/75	75	
		JUL 3/76	10	
		JUL 15/81	82	
88	SATELLITE CHANNEL (92B/12)	AUG 19/82	150	
		AUG 10/72	100	
		JUL 15/75	75	
89	CHERRY POINT (92B/12)	JUL 13/74	150	
		JUL 15/51	57	
90	WHIFFIN SPIT, SOOKE (92B/5)	JUL 11/44	200±	
		JUL 11/44	150±	

Appendix 4. Results of aerial and ground surveys carried out in August 1980 in the Hecate Strait area.

4.1 Location of survey lines in Portland Inlet.

4.2 Location of survey lines over Hecate Strait and Dixon Entrance.

4.3 Portland and Observatory inlets: Aerial survey done on July 28.

4.4 Stephens Island and Porchers Peninsula: aerial survey done on July 28.

4.5 Kitkatla Inlet and Banks Island: aerial survey done on July 29.

4.6 East shore of Graham Island: aerial survey done on July 20.

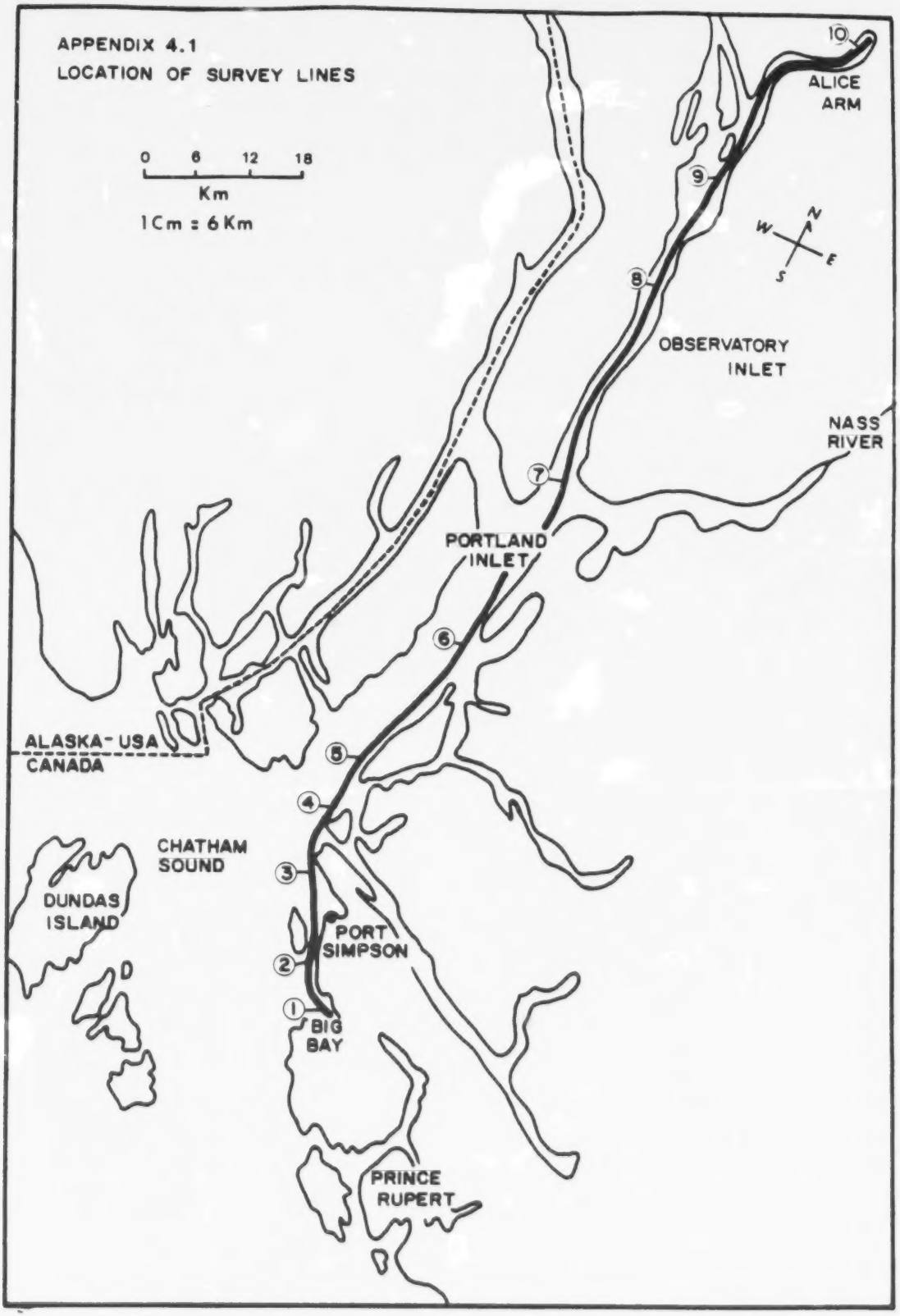
4.7 Chatham Sound: aerial survey done on July 30.

4.8 McIntyre Bay and Naden Harbour: aerial survey done on July 30.

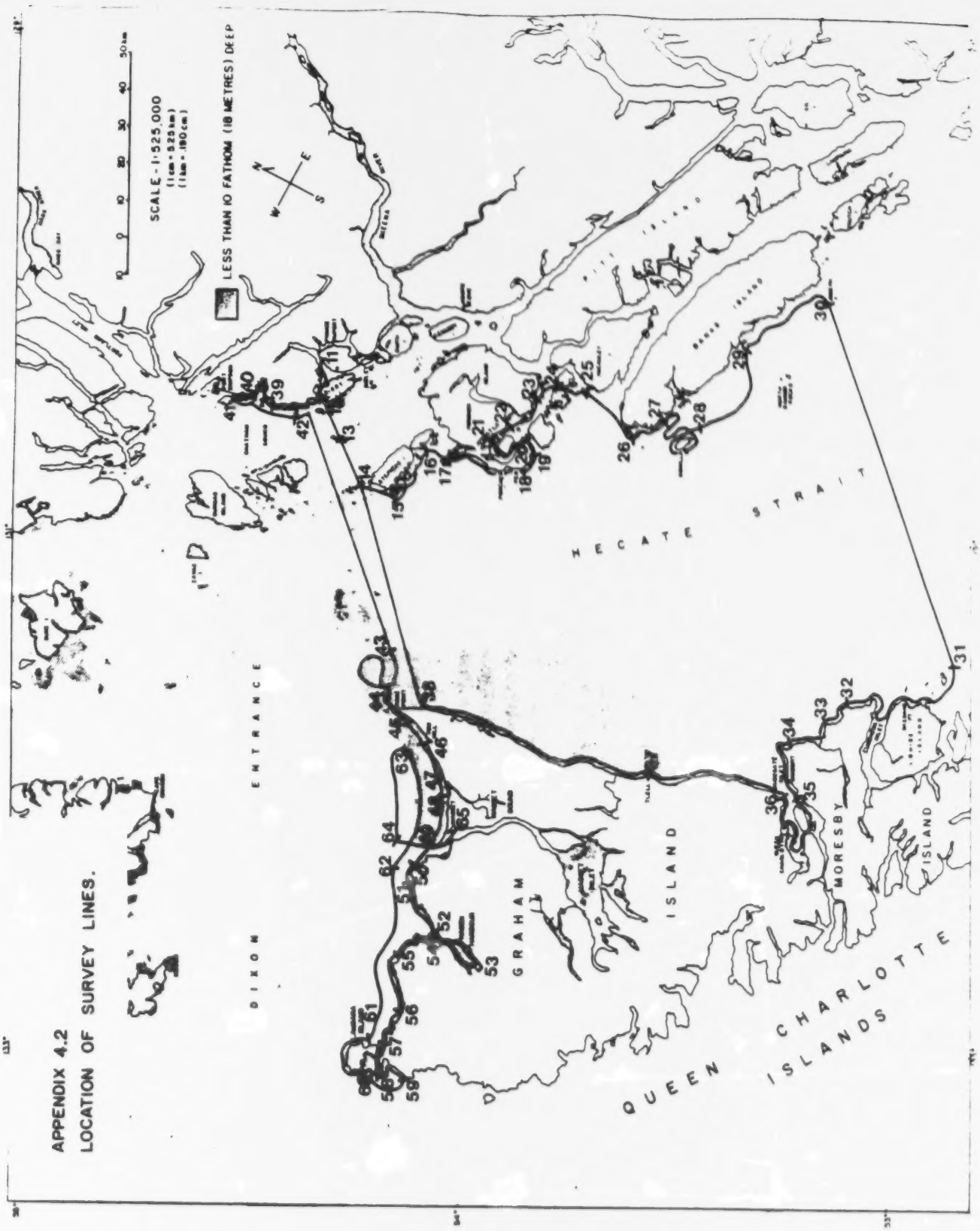
4.9 Langara Island and McIntyre Bay: aerial survey done on July 30.

4.10 Location of ground surveys on the Queen Charlotte Islands.

4.11 Sandspit to Tlell: ground survey done on July 31.



Appendix 4.1 Location of survey lines in Portland Inlet.



Appendix 4.2 Location of survey lines over Hecate Strait and Dixon Entrance.

Appendix 4.3 Portland and Observatory inlets: Aerial survey done on July 28, 1980, from 1645 h to 1940 h.

Section	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10
Loon	3								
Dabbling Duck									
Surf Scoter									55
Scoter sp.	186								800
Duck									
Black Turnstone		4000							
Shorebird						1	1		
Bonaparte's Gull	9	30							
Gull		60	8			5	3	12	

Appendix 4.4 Stephens Island and Porchers Peninsula. Aerial survey done on July 28, 1980 between 0853 h and 0945 h.

Section	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20
Common Loon								2	
Cormorant				3					
Harlequin Duck							10		
White-winged Scoter		2						3	
Surf Scoter				2		50	18	18	
Scoter sp.	3	31		5		14	153	43	
Duck	2		10		5	10	4		
Rock Sandpiper		15							
Shorebird	41	20		55					
Gull	80	1	3	2	1			12	
Pigeon Guillemot							1		

Appendix 4.5 Kitkatla Inlet and Banks Island: Aerial survey done on July 29, 1980 between 0945 h and 1054 h.

Section	20-21	21-22	22-23	23-24	24-25	25-26	26-27	27-28	28-29	29-30	30-31
Common Loon					1			1			
Shearwater											1
Great Blue Heron								2			
White-winged Scoter							18	1538			
Surf Scoter	10		5								
Scoter sp.	25	15		68			1	71		11	2
Common Merganser	8										
Merganser				15							
Bald Eagle				1							
Rock Sandpiper								18			
Gull		1						20			3
Murre											12
Alcid											1
Duck											
Cormorant								4	4		8

Appendix 4.6 East shore Graham island: Aerial survey done on July 20, 1980 between 1130 h and 1500 h.

Section	31-32	32-33	33-34	34-35	35-36	36-37	37-38	38-14	14-12	12-11
Common Loon	1					4				
Western Grebe					8					
Shearwater							2	81		
Fork-tailed Storm-petrel								1		
White-winged Scoter	155		1	53	312	10	28	13		1
Surf Scoter			30		62	2	26			50
Scoter sp.			40	2	423	5	71	41	3	1
Duck										
Shorebird										30
Gull					100		13	4	20	
Murre								12	23	
Pigeon Guillemot					38				1	
Alcid								12		5
Rhinoceros Auklet									83	

Appendix 4.7 Chatham Sound: Aerial survey done on July 30, 1980 between 0850 h and 0950 h.

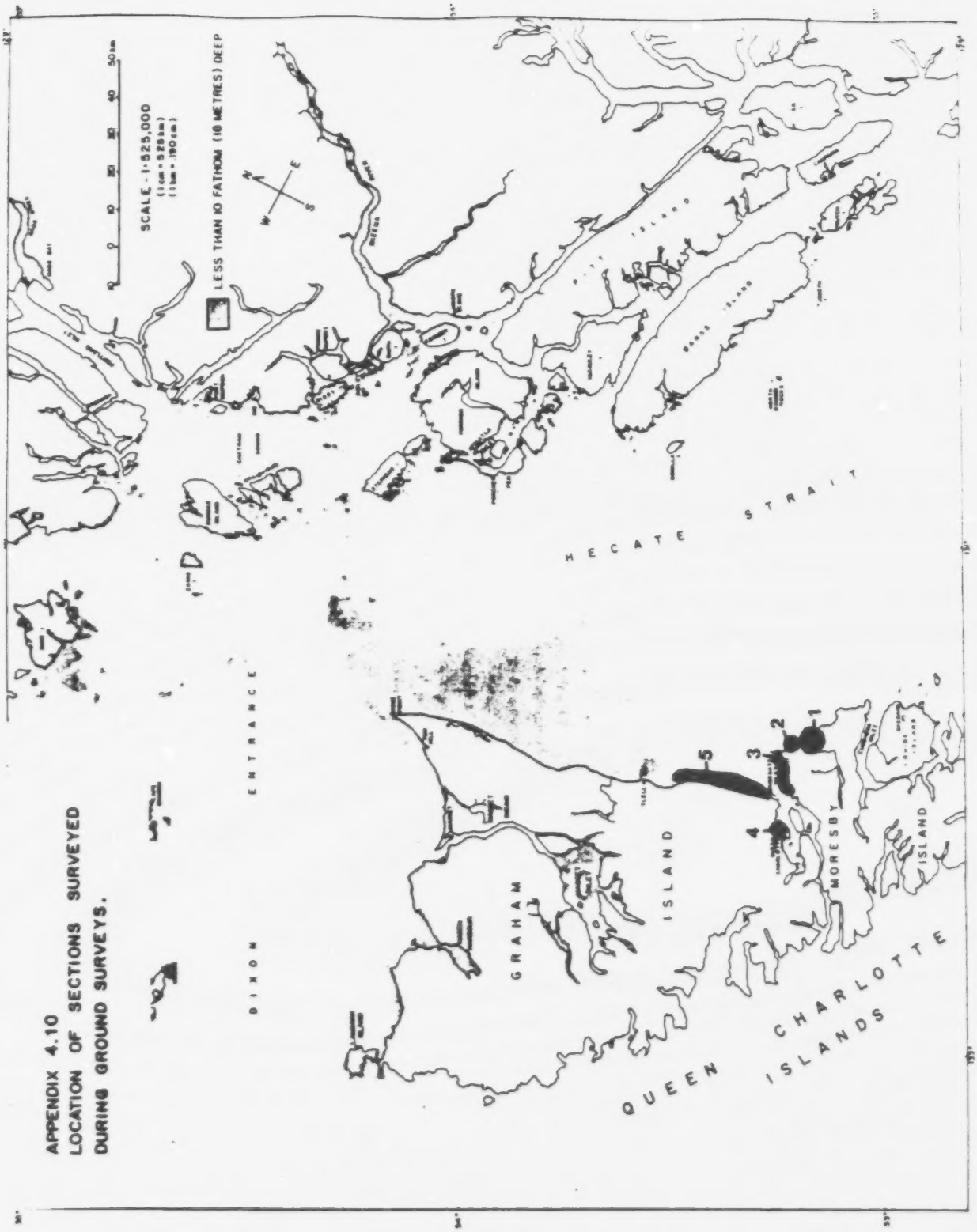
Section	11-39	39-40	40-41	41-42	42-14	14-43	43-44
Loon	1	1					
Red-necked Grebe		8					
Western Grebe		10					
Shearwater							9
Storm Petrel						1	
Cormorant	3						1
Great Blue Heron		2					
Canada Goose		6	50				
Scaup	8						
White-winged Scoter		13	28	258	4	8	17
Surf Scoter							
Scoter	50	59		120			38
Common Merganser	9						
Merganser		7					
Bald Eagle	1						
Turnstone			40				
Dowitcher			10				
Yellowleg	2	1					
Shorebird	82	18	71	150		6	
Gull	703	612		57			
Murre				6		1	
Pigeon Guillemot				3		1	
Alcid						5	
Rhinoceros Auklet				787			

Appendix 4.8 McIntyre Bay and Naden Harbour: Aerial survey done on July 30, 1980 between 1000 h and 1100 h.

Section	44-45	45-46	46-47	47-48	48-49	49-50	50-51	51-52	52-53	53-54	54-55
Common Loon				7			1	3	2		3
Arctic Loon	1	2		20				65			
Loon	3	5	1	8			8		4	1	
Grebe							2				
Shearwater	39										
Cormorant							1	2			2
Great Blue Heron									1		
Canada Goose									50		
Scaup								3		50	
Oldsquaw		1									
Harlequin Duck								9			
White-winged Scoter		43	29	48	8		117	321	4	67	8
Surf Scoter		72	8	49					7	90	40
Scoter	1	70	13	37	2		5	48	10		4
Bald Eagle			1								
Wandering Tattler									5		
Shorebird		25	90						1		25
Gull	2052			115	5			15	54	8	6
Murre	4					4	5				
Alcid	2									1	
Rhinoceros Auklet	44					14	29	40		2	
Common Merganser											11

Appendix 4.9 Langara Island and McIntyre Bay: Aerial survey done on July 30, 1980 between 1100 h and 1300 h.

Section	55-56	56-57	57-58	58-59	59-60	60-61	61-62	62-63	63-64	64-65
Common Loon	1	2				6	1		1	
Arctic Loon				16				54	8	
Loon	1	12				1		2		
Red-necked Grebe								1		
Western Grebe	1									
Shearwater						2	11		22	17
Pelagic Cormorant				1						
Cormorant	12	2	4	6	15	4				
Scaup	1									
White-winged Scoter	32	60		75	14	1	83	374	324	
Surf Scoter							20	1		
Scoter	12	85	10	13		23	9	10	1	
Common Merganser		11								
Black Oystercatcher					2					
Shorebird		40								
Gull	600				305	70				
Murre		22			3	354	74	6	14	
Pigeon Guillemot				77	95					
Alcid	2				2	5				1
Rhinoceros Auklet	134	1	17	76	143	156	42	12	50	5
Duck sp.	10	5								



Appendix 4.10 Location of ground surveys on the Queen Charlotte Islands.

Appendix 4.11 Sandspit to Tlell: Ground survey done on July 31, 1980 from 1138 h to 1800 h.

Section	1	2	3	4	5
Common Loon	2		3		
Arctic Loon			1		
Loon		2			7
Red-necked Grebe	3	1	6	7	6
Cormorant			12	2	2
Scaup				9	
Harlequin Duck			23		4
White-winged Scoter	66	42	104	76	112
Surf Scoter				235	6
Black Scoter			4		22
Scoter sp.				52	18
Bald Eagle	1	1	1		
Black Oystercatcher			4		
Wandering Tattler			1		4
Gull			200		
Pigeon Guillemot			7		
Marbled Murrelet	2	7	2	4	6

Appendix 5. Results of Aerial surveys conducted on August 14, 1985 in Boundary Bay, Indian Arm and Howe Sound.

5.1 Location of survey lines

Appendix 5. Results of an aerial survey conducted on August 14, 1985 in Boundary Bay, Indian Arm and Howe Sound.

The purpose of the survey was to assess the number of moulting scoters in Boundary Bay and to locate moulting concentrations of ducks in Indian Arm and Howe Sound. The survey was flown at 200 feet in a Cessna 185 on floats. The route followed in Indian Arm and Howe Sound is mapped in Appendix 5.1. The survey started at 1000h. The tide was low. The observers were Rick McKelvey and Jean-Pierre L. Savard.

Fraser Foreshore

We flew over the tide line which was far from shore because of the low tide. No birds were observed over Sturgeon Banks. Two flocks of Surf Scoters were located on Roberts Bank. One estimated at 200 birds just west of the Coal Terminal (Appendix 5.2, No. 1) and one between the coal jetty and the ferry jetty estimated at 100 birds (Appendix 5.1, No. 2).

Boundary Bay

We flew first at 700 feet to locate concentrations of scoters and then carried out a few transects at 200 feet. Scoters were scattered in small groups ranging from 40 to 300 individuals. Both Surf and White-winged scoters were present. Surf Scoters seemed to outnumber White-winged Scoters. Scoters were concentrated in two areas of the Bay, first approximately in front of the Boundary Bay Airport and

1 200 SURF SCOTER
2 100 SURF SCOTER
3 c. 2000 SURF & WHITE WINGED SCOTER
4 1500 SURF & WHITE WINGED SCOTER
5 50 HARLEQUIN DUCKS
6 100 RED-NECKED GREBES
7 300 SURF SCOTER
8 400 SURF SCOTER
9 24 SURF SCOTER
10 75 SURF SCOTER

Appendix 5.1 Boundary Bay Indian Arm and Howe Sound
Molting Bird Survey - August 14 1986

Appendix 5.1 Location of survey lines in Boundary Bay, Indian Arm and Howe Sound on August 14, 1986.

second, just offshore of Kwomais Point (Appendix 5.1). I estimated between 3,000 and 4,000 scoters in the Bay. Scoters were difficult to locate and count because of the survey conditions. During a survey flown over the Bay on September 19, 1985, scoters were concentrated in the same two sections of the Bay as on August 14. A few hundred seals were loafing along the tide channels. Fifty Harlequin Ducks were counted near Kwomais Point. They were difficult to see from the air. Red-necked Grebes were observed (~100) over the eelgrass bed off Crescent Beach (Appendix 5.1).

Indian Arm

No concentration of waterfowl was located in Indian Arm. The area was characterized by the absence of birds. The shoreline appears to support few mussel beds. Only a few patches of mussels were seen from the air. We only saw a few Common Mergansers (Mergus merganser) and Common Loons.

Howe Sound

No concentration of waterfowl was seen between the Lions Gate Bridge and Horseshoe Bay. In fact only three concentrations of scoters were located along the route flown in Howe Sound. The first group of scoters was seen near Christie Islet (Appendix 5.2) and comprised approximately 300 scoters, mostly Surf Scoters. The second group was near the Defence Islands (Appendix 5) and was estimated at 400 individuals, mostly Surf Scoters. Finally, the third concentration was seen between Hutt Island and Bowen Island

(Appendix 5.1) and comprised 75 Surf Scoters mostly females and still capable of flight.

Appendix 6. Results of aerial surveys conducted on August 7, 8 and 25, 1986 around Hecate Strait.

6.1 Location of survey lines in Observatory Inlet, Hecate Strait and Douglas Channel.

6.2 Skidegate Inlet (Insert A)

6.3 Alice Arm (Insert B)

Appendix 6. Results of aerial surveys conducted on August 7, 8 and 25, 1986 around Hecate Strait.

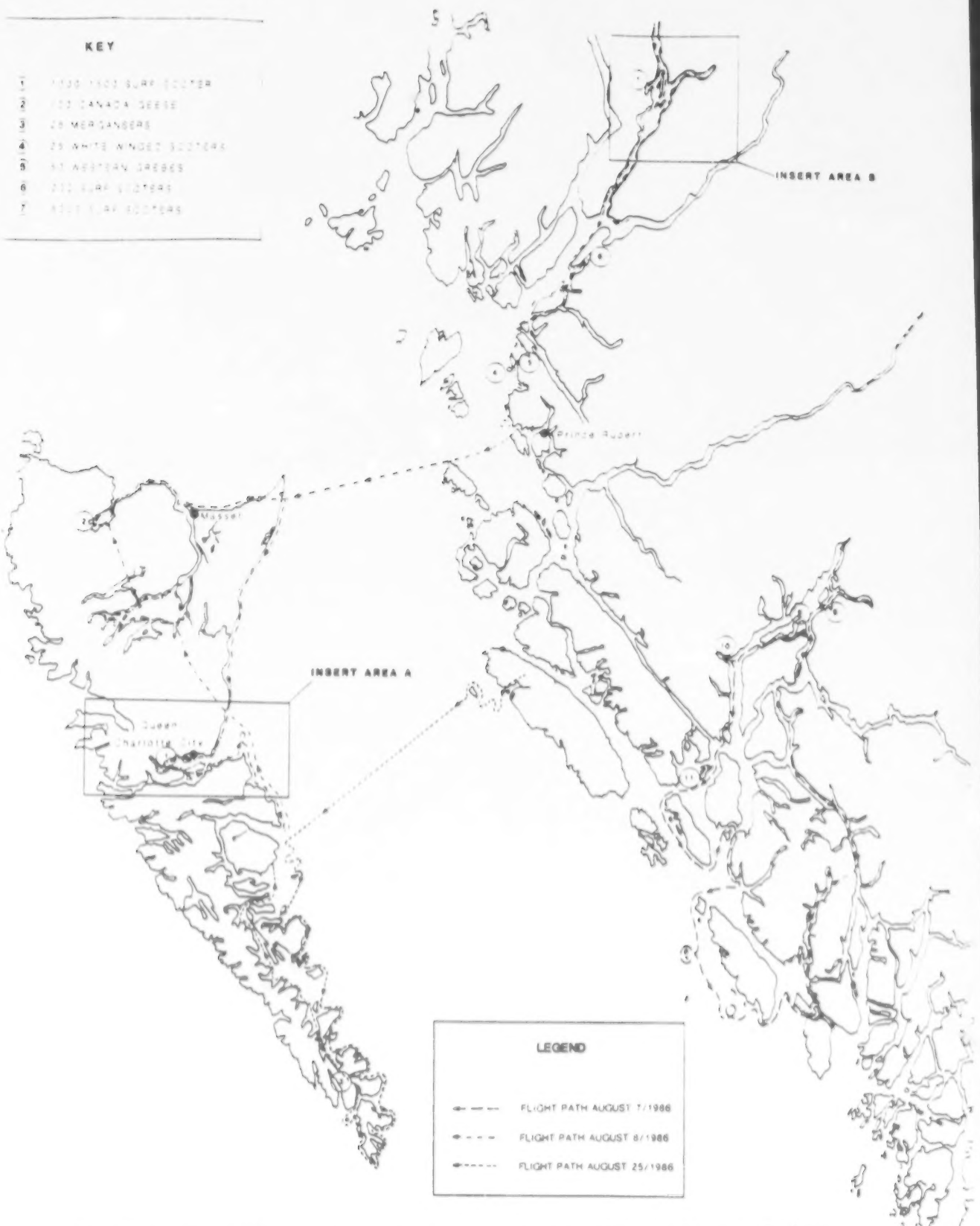
The purpose of these surveys was to locate concentrations of moulting seaducks. The surveys were flown in a Cessna 337 at altitudes ranging between 50 and 100 m. On August 7 and 8, three observers looked for concentrations of birds and on August 25, only two observers.

Kitimat Arm and Moore Islands

Only one major concentration was located during this survey (August 7, Appendix 6.1). It was located at the north end of Devastation Channel near Kersey Point (Appendix 6.1, No. 8-9). A smaller flock was seen in Kitkiatka Inlet (No. 10 ≃ 200 Surf Scoters) and a small group of 75 Surf Scoters was seen at the south end of Fin Island (Appendix 6.1, No. 11). No other concentrations of birds were seen along the surveyed route.

Observatory Inlet, Skidegate Inlet, Masset Inlet, Naden Harbour and Hecate Strait

The survey was flown on August 8 (Appendix 6.1) and two major concentrations of Surf Scoters were located. The largest concentration totalled close to 5,000 Surf Scoters and was located around the islands at the intersection of Alice and Hastings arms (Appendix 6.1, No. 7). Group size ranged from 50 to over 3,000 scoters scattered among the islands. The location of the major flocks is shown in Appendix 6.2. A small flock of 200 Surf Scoters was seen in



Appendix 6.1 Location of survey lines in Observatory Inlet, Hecate Strait and Douglas Channel.

Appendix 6.2 Insert area B: location of survey line near Alice Arm.

Nasaga Gulf near the mouth of Portland Inlet (Appendix 6.1, No. 6). The only other large group of moulting scoters was found in Skidegate Inlet where 1,500 Surf Scoters were counted (Appendices 6.1, 6.3). No large flocks of moulting seaducks were encountered along the rest of the survey route. A few groups of mergansers were seen in Masset Inlet, but those may have been old broods.

Moresby Island and Bonilla Island

No concentrations were located on August 25 along this line (Appendix 6.1). However, because of the size of this area and the small area covered by our survey line, it is possible that concentrations were overlooked.

Appendix 6.3 Insert area A: location of survey lines in Skidegate Inlet.